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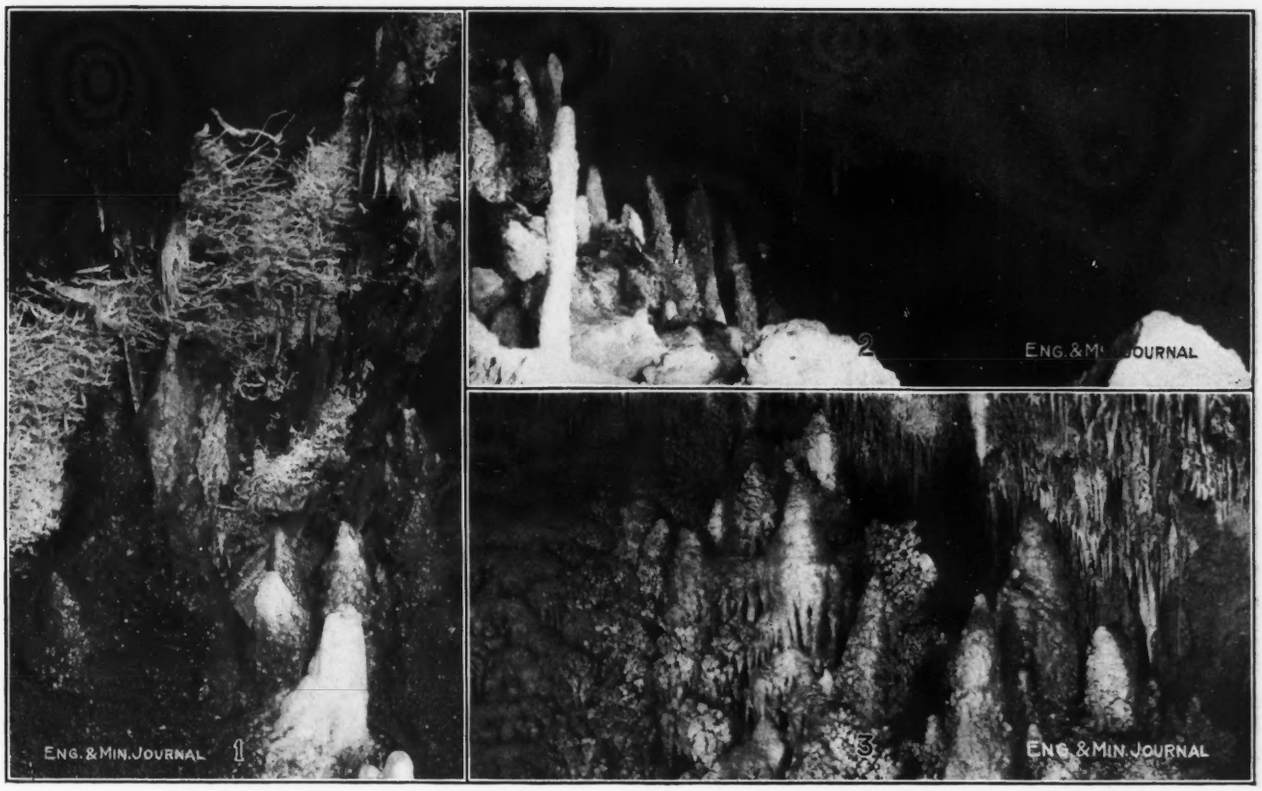
A Cavern in the Shattuck Mine

By Philip D. Wilson*

SYNOPSIS—Large natural caverns have been found in the mines of the Bisbee district in Arizona, where limestone is associated with porphyry. The most recent cavern to be opened is that in the Shattuck mine, the largest and most beautiful so far found.

Recently in the course of development work in the mine of the Shattuck Arizona Copper Co. at Bisbee, Ariz., there was encountered what is, both on account of its size and rare beauty, probably the most remarkable natural cavern in the country; perhaps in the world. Other caverns somewhat similar have been opened in the Bisbee district. A cavern in one of the older portions of the Copper Queen mine has become famous locally as the auditorium in which a large fraternal organization met in solemn conclave in the earlier days of the camp, and another cavern brought to light more recently in another part of the same mine has been transported almost in its entirety to the Museum of Natural History in New York. But both of these and others of less renown are insignificant before the one more recently opened.

It was first discovered by a drift on the 300-ft. level which fortuitously struck it in its lowest and in a central point. A drift a few feet on either side would have passed beneath it and have left it perhaps unknown for years. In shape it is a huge lens approximately following the bedding planes of the inclosing limestone at an inclination of about 35° and it is roughly circular in horizontal projection. Its upper extremity is 172 ft. above the 300-ft. level and the diameter of its circular projec-



Calcite Stalactites and Stalagmites in a Cavern in the Shattuck Mine, Bisbee, Ariz.
1, a unique stalactitic growth, locally called "wiggle tails"; 2, roof and floor, and 3, sides of the cavern.

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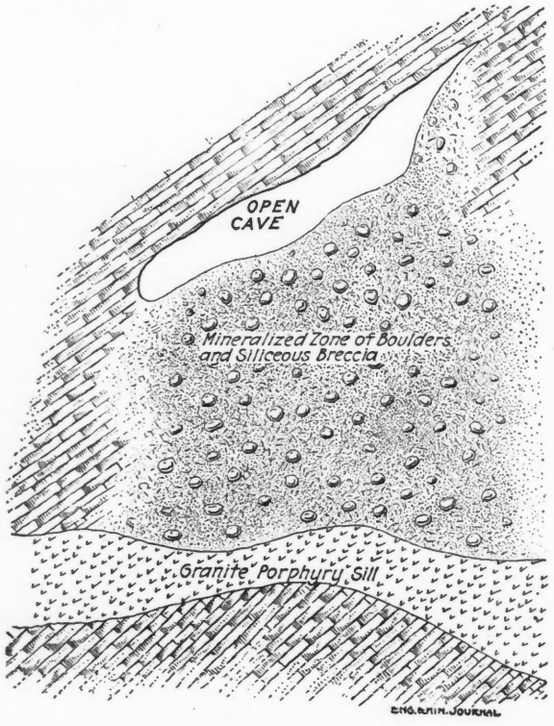
tion is 340 ft. The vertical distance between roof and floor where its height is greatest has been roughly estimated at 80 feet.

One's first impression of this great cavern now electric lighted, with its stalactite studded dome, is that of the shadowy interior of a Gothic cathedral. Close examination reveals myriad forms of calcite, crystalline and amorphous, with all its vagaries of structure and color. It is apparent from the structure that a lime-impregnated solution has filled portions of the cavern subsequent to the original formation of the stalactites and stalagmites; left its quota of mineral as arborescent, coral-like deposits on the stalagmites, and afterward drained away. In many cases a second generation of stalagmites has formed, and in places there is evidence that this alternation of aërial and subaqueous deposition has taken place several times. A unique occurrence is shown in the first, that at the left, of the accompanying photographs. Known in local mine parlance as "calcite



IDEAL GEOLOGICAL SECTION OF SHATTUCK CAVERN

wiggletails" these curious serpentine growths ranging from ⅛ to ½ in. in diameter, emanate from the limestone hanging wall in the most amazing spirals and volutes or shoot out at every conceivable angle. Each one, as described by Prof. Alexander H. Phillips, of Princeton University, seems to be a complex parallel growth of elongated and curved rhombohedrons.

Directly beneath the cave is a zone of boulders and detritus cemented with calcite, and below that again is a huge irregular mass of siliceous breccia. The breccia zone extends to within a few feet of the 700-ft. level, where it rests on a sill of granite porphyry of great lateral extent and variable thickness. Throughout the detritus zone and the mass of siliceous breccia are scattered shoots of high-grade copper and lead-silver ore. Associated with this breccia are found several rare minerals unique to the Shattuck, most noteworthy of which is a deposit of a rare copper-lead vanadate, a non-zinkiferous cuprodescolizite.

Several conjectures have been advanced to explain the origin of this cavern. It is probable that the shrinkage contingent upon the solidification and cooling of the intrusive mass shattered and opened the rock mass for a great distance above it. The contemporaneous induration of the brecciated material by the siliceous magmatic emanations from the porphyry entailed a further loss in volume. This left a large open space easily accessible to acid meteoric waters which enlarged the cavity to its present size and left it ready for the calcium carbonate.

Copper Queen Leaching Experiments

SPECIAL CORRESPONDENCE

The experimental process at present being used by the Copper Queen company, at Douglas, Ariz., for the wet extraction of copper, is as follows:

The ore is given a sulphatizing roast in a Wedge furnace with the object of getting as much ore as possible in form soluble in water. This roast is leached with a dilute sulphuric-acid solution—about 6%—after leaching the liquor contains probably ½% free acid. The leach liquor is transferred to the electrolytic tanks (carbon anodes, "starting-sheet" cathodes, 1.25 amp. per sq.ft. current density), and SO_2 blown in for four hours without any current passing. Then electrolysis is begun and SO_2 blown in for eight hours more, after which the electrolyte is so far depleted of copper as to render further treatment not economical. Now the acid in the electrolyte is high enough for leaching and the electrolyte is transferred to the leaching tanks. The SO_2 comes from the McDougal roasters, after passing two dust traps and is pumped direct to the tanks.

Phelps, Dodge & Co.'s report for 1913 contains the following report by Mr. Van Arsdale, who worked out the process, on the leaching experiments:

During the year an experimental plant was completed and experiments were conducted principally with the view of determining the best method of leaching low-grade ores and tailings from the concentrators. A Wedge furnace of the muffle type was erected, which produced calcines containing a high portion of their copper soluble in water, and practically all of the remainder soluble in dilute acid, but with a high fuel consumption.

The recovery of the dissolved copper was effected by electrolysis, using graphite anodes, and reducing the resistance and increasing the yield of sulphuric acid, by injecting sulphur dioxide into the electrolyte. The results were favorable, but several problems which presented themselves, as the experiments progressed, remain to be solved, as well as a reduction of the high fuel consumption, before definite conclusions can be reached.

Temperature of Cyanide Solutions

The general effect of a rise in temperature on the effect of cyanide treatment solutions has been the subject of much study. An increase of extraction is the usual result, the solution becoming a more active solvent. At the Liberty Bell mill, Teluride, Colo., raised temperatures were at first believed to assist amalgamation more than the cyanide extraction, but further investigation showed the increase was really due to increased dissolution, conforming to general practice.

The Action of Iron Sulphides on Copper Solutions

By Stuart Croasdale*

SYNOPSIS—Some experiments on the precipitation of copper from solution by means of natural and artificial sulphides of iron and copper. Some natural sulphides seem to be possible commercial precipitants in hydrometallurgical work, others will not work. Artificial sulphides, mattes, offer hope only in most unusual cases.

During April and May, 1911, I conducted some preliminary experiments on the commercial separation of copper from arsenic in a sulphuric-acid solution. The requisites of greatest importance in connection with these experiments were to use the reagents already on hand and to remove the copper completely from solution contaminated with as little arsenic as possible. It was more important in this case to have the arsenic free from copper than to have the precipitated copper free from arsenic, although, of course, it was desired to make as close a separation of the two metals as possible.

The cheapest and most convenient reagents available were natural and artificial sulphides of iron and copper; the former existing as a copper-bearing iron pyrite carrying more or less zinc, and the latter as a low-grade iron matte or the usual grade of copper matte.

Attempt to Use Sulphides Instead of Sulphuretted Hydrogen

Since fractional or selective precipitation was frequently done in the old days of "hyposulphite" and chlorination processes, the thought occurred to me that I might be able to use a solid sulphide of iron for this purpose instead of going to the trouble of making hydrogen sulphide. With this idea in mind, my attention was naturally drawn to the pioneer work of H. V. Winchell on "The Synthesis of Chalcocite and Its Genesis at Butte."[1] His argument on the formation of this sulphide of copper is as follows:

"It should be remembered that hydrogen sulphide and soluble sulphides normally precipitate CuS (not Cu_2S) from copper solutions, whether acid or alkaline. . . . . It, therefore, becomes at once apparent that the precipitating agent in these veins cannot have been a soluble sulphide, unless there were at the same time a reducing agent strong enough to reduce the cupric sulphate to cuprous sulphate and precipitate cuprous sulphide, and not strong enough to reduce it to native copper."

Mr. Winchell made two experiments by placing copper-bearing iron pyrite (jig concentrates) in glass jars. One jar was filled with a slightly acid solution of copper sulphate containing SO_2 and the other with a similar solution without SO_2. Both jars were sealed and allowed to stand, at ordinary temperatures, for three months. At the end of this time the pyrite in the jar containing SO_2 was completely plated with a black mineral resembling chalcocite, while the pyrite in the other jar remained unchanged. The copper contents of the pyrite in the first jar was also increased from 1.5% to 3.6%.

Mr. Winchell further states that "the experiments repeatedly showed that SO_2 is formed by the action of pyrite and chalcopyrite upon $CuSO_4$"; and also that " a solution of copper sulphate was treated with the sulphides of arsenic, lead, copper, iron, zinc and with pyrite; and in each case, copper sulphide was precipitated, proving that these sulphides may precipitate copper sulphide from solution of a copper salt."

Natural Formation of Cu_2S Not Fully Explained

"It was not ascertained whether the iron salts will reduce enough copper to form Cu_2S in presence of pyrite or other sulphides, or whether the SO_2 formed by solution of the pyrite and other sulphides is the active agent."

The reactions he gives to support his theory are stated briefly as follows:

$$FeS_2 + H_2O + 6\ O = FeSO_4 + SO_2 + H_2O$$

The SO_2, perhaps, aided by the ferrous sulphate, reduces a portion of the cupric sulphate to cuprous sulphate as follows:

$$2\ CuSO_4 + SO_2 + 2\ H_2O = Cu_2SO_4 + 2\ H_2SO_4$$
$$Cu_2SO_4 + FeS_2 = FeSO_4 + Cu_2S + S$$

He says CuS would be formed except for the presence of SO_2 which holds the copper in the form of cuprous sulphate, and makes the precipitate cuprous sulphide.

W. H. Emmons[2] says, however, "the inference that cuprous ions form in this reaction has not received universal acceptance because cuprous salts have not been identified in mine waters. Cuprous sulphate is a very unstable compound. It may be held in solution in some substances, but it is stated that when placed in water it quickly becomes cupric sulphate."

R. C. Wells[3] has shown that cuprous ions may exist in exceedingly small concentration under conditions similar to those where sulphate waters attack the sulphides of iron and copper.

Dr. H. N. Stokes has shown, according to Lindgren[4], that a neutral solution of cupric sulphate will act on pyrite at 100 to 180° C., as follows:

$$5\ FeS_2 + 14\ CuSO_4 + 12\ H_2O = 7\ Cu_2S + 5\ FeSO_4 + 9\ H_2SO_4 + 3\ H_2SO_4$$

The last H_2SO_4 is formed by the oxidation of the sulphur of FeS_2. The formation of H_2SO_4 was proved by quantitative analysis. The reaction is, however, not as simple as thus expressed for some CuS is formed, less at 100° than at 180°. Cuprous sulphate also plays a part in the reaction as an intermediate product. He also found that dilute sulphuric acid does not act on pyrite but does attack cupriferous pyrite and chalcopyrite.

Knopf[5] says that while the above reaction has been commonly accepted as expressing the chemical change of pyrite to chalcocite, it has been found to be "incom-

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[1]"Eng. and Min. Journ., May 23, 1903.

[2]"The Enrichment of Sulphide Ores," Bull. 529, U. S. Geol. Surv., p. 52.

[3]Econ. Geol., Vol. 5, 1910, p. 432; also Bull. 529, U. S. Geol. Surv., p. 52.

[4]Prof. Paper No. 43, U. S. Geol. Surv., p. 183.

[5]"Eng. and Min. Journ.," Jan. 10, 1914.

patible with the actual volume relations observable," and would call for "an expansion in volume of the transformed pyrite of from 54 to 75% when the reaction actually seems to proceed according to the law of equal volumes."

A. C. Spencer[6] considers the reaction as comprising several stages, as follows:

$$2\ FeS_2 + 2\ CuSO_4 = Cu_2S + 2\ FeSO_4 + S$$

$$3\ S + 2\ CuSO_4 = Cu_2S + 4\ SO_2$$

$$6\ H_2O + 5\ SO_2 + 2\ CuSO_4 = Cu_2S + 6\ H_2SO_4$$

to which W. H. Emmons[7] adds, "The reactions may differ as to details, but without much doubt ferrous sulphate and acid are set free."

W. H. Weed[8] says, "Both glance and covellite can easily be produced by action of cupric sulphate on unaltered primary sulphides."

W. Lindgren[9] found copper sulphide replacing both blende and pyrite at Morenci, Ariz., and says, "The pyrite apparently does not precipitate Cu_2S or CuS while blende is present."

Covellite or cupric sulphide, while not so abundant as chalcocite, is formed, according to many geologists, chiefly as a replacement of iron and zinc sulphides. Since the precipitation of cupric sulphide from cupric-sulphate solutions involves no change of valence the reactions involved are probably simple, except with pyrite. Covellite seems to be formed in a reducing environment like chalcocite, although some ferric sulphate may also be present.[10]

Grout,[11] on the other hand, says: "Attempts to form copper and silver sulphides from dilute acid solutions under conditions like those assumed to exist where these metals are forming enriched sulphides, have been singularly disappointing, although a large number of combinations of solutions and minerals have been tried and in some experiments the action has been watched for 18 months."

Mr. Grout then observes that gold and silver are precipitated from acid solutions in metallic form by several minerals, yet in nature it is the secondary sulphides of silver and copper, rather than the metals, which are formed.

Ore Occurrence Points to Sulphides as Precipitants

The foregoing data (and much more could be cited) seem to leave little doubt that the natural sulphides of the more electro-positive metals, even to copper sulphide itself, will precipitate copper as a sulphide from its solutions. In hydrometallurgical work it would, of course, be immaterial whether the cupric or cuprous sulphide be formed, although cuprous sulphide would be a higher-grade precipitate, and more desirable. Since chalcocite is much more abundant in nature than covellite, it would seem that cuprous sulphide is more easily precipitated in spite of the more complicated reaction. In any case, barring the speed of the reactions, which might or might not interfere with their commercial use, there were sufficient reasons for believing that these natural sulphides might answer my purpose as a precipitant for copper.

Owing to the preliminary character of these experiments, qualitative, not quantitative tests were made, and since then this work has never been completed.

With a dilute sulphuric-acid solution of copper and arsenic, containing not over 2% copper, I found that pyrite, either pure or copper-bearing, removed all of the copper from solution in preference to the arsenic, but on standing 24 to 48 hr. with a large excess of the precipitant both the copper and arsenic were completely removed from solution.

Some of the complex iron-lead-zinc sulphides acted more rapidly than the pyrite. This was probably due to the chemical composition of the minerals where the metals occurred as double and lower sulphides, and were more easily decomposed. On the other hand, certain zinc sulphides did not act as rapidly as the copper-bearing iron pyrite.

In these experiments the arsenic was present in the "ous" condition and no doubt formed the reducing environment which the investigators just mentioned found essential for the formation of chalcocite.

On the other hand, I treated a slightly acidified copper-sulphate solution containing about 2.5% copper and 1% iron, equally divided as ferrous and ferric sulphate, with a mixture of iron pyrite and chalcopyrite, and obtained no appreciable precipitation of the copper from solution after standing a week. No reducing agent was added and the comparatively large amount of ferric sulphate present would have prevented the formation of any reducing agent other than ferrous sulphate; yet the reaction with chalcopyrite, as Emmons[12] suggests, might be simple.

$$CuFeS_2 + CuSO_4 = 2\ CuS + FeSO_4$$

The iron here might be considered as the monosulphide (FeS) which should be more readily attacked than pyrite, but, as will be shown later with artificial sulphides or iron, the tendency, as in nature, is to form cuprous sulphide or metallic copper rather than cupric sulphide.

It might be said, with reason, that the reactions between copper solutions and the natural sulphides of iron are too slow to have any commercial value. This may be true in some cases, but not necessarily in all, for I found some sulphides that precipitated copper rapidly.

Great Need of Hydrometallurgy Will Be Cheap Precipitation

The extensive work now being done in hydrometallurgy of copper is going to depend chiefly on a cheap method of precipitation for its success. The precipitant used will depend on the character of the ore treated, the character of the lixivium obtained and the local conditions under which operations are conducted. Even when electrolytic precipitation can be used the copper in foul and in the excess of weak solutions will have to be recovered by chemical reagents in some form.

Nearly all of the "carbonate" or oxidized ores that are available for leaching methods are underlaid with sulphide ores, either primary or secondary in character. If primary, the sulphide minerals are likely to be pyrite and chalcopyrite; if secondary, pyrite and chalcocite.

For some time to come these sulphide ores will continue to be treated by some method of mechanical concentration and the concentrates will be roasted and smelted

[6]"Journ. Wash. Acad. Sci.," Vol. 3, 1913, p. 73; Bull. 529, U. S. Geol. Surv., p. 133.

[7]Bull. 529, U. S. Geol. Surv., p. 134.

[8]"Geol. and Ore Deposits of Butte," Prof. Paper No. 14, U. S. Geol. Surv., p. 102.

[9]Prof. Paper No. 43, U. S. Geol. Surv., p. 182.

[10]W. H. Emmons, Bull. 529, U. S. Geol. Surv., p. 110.

[11]"Alkaline Extracts of Metallic Sulphides," Econ. Geol., August, 1913.

[12]Bull. 529, U. S. Geol. Surv., p. 110.

in the usual manner. Any copper precipitate obtained from lixiviums by means of chemical reagents will, in all probability, have to be smelted in a similar manner or sent direct to the converters of some smeltery. Therefore, if the concentrates from the sulphide ores on any property can be made to precipitate copper from solution with reasonable speed, regardless of their efficiency as a precipitant, it should be entirely feasible to operate plants for both classes of ore simultaneously, and thereby, not only obtain a cheap precipitant for the copper in the lixiviums but at the same time enrich the concentrates in transit to their destination. If sulphuric acid is used for leaching, they might also be roasted at the mine to furnish all or part of the acid required.

As stated in the beginning of this article, the artificial sulphide of iron, in the form of iron and copper matte, was also available as a reagent in my work for precipitating copper from solution. This was tested qualitatively, but owing to other engagements, the work was not continued until the next year under different conditions.

Copper in Sulphides Prevents Precipitation

The preliminary tests had already shown that pure ferrous sulphide precipitated copper in metallic form and not as sulphide, while a 45% copper matte gave no appreciable precipitate of copper in any form.

One would naturally expect the reaction between ferrous sulphide and copper sulphate to be a simple transposition of the metals, similar to the reactions with hydrogen or other soluble sulphides; thus,

$$FeS + CuSO_4 = CuS + FeSO_4$$

However, since metallic copper was invariably precipitated from neutral or slightly acidified solutions, without the liberation of sulphur, hydrogen sulphide or sulphur dioxide, I made two sets of experiments to determine, not only the true reaction but also the precipitating value of sulphide of iron. One set of experiments was made with pure ferrous sulphide obtained from a manufacturer of pure chemicals and the other was made with an iron matte made from pyrite. Both the ferrous sulphide and the iron matte contained, by analysis, 65% iron, and it was on this basis that their precipitating values were estimated.

A standard solution of copper sulphate was made containing 2% copper which is near the strength of the average lixivium from leaching operations.

One gram of ferrous sulphide or iron matte was weighed for each test and sufficient standard copper-sulphate solution was added to replace theoretically *all* of the iron in the one gram of sulphide. This was called the theoretical quantity of copper. The variation tests ranged from one-eighth of this theoretical amount of copper-sulphate solution to twice the theoretical quantity. The copper always came down in metallic form and the precipitation invariably ceased when about one-quarter of the theoretical amount of copper was precipitated. This was checked by analyses of both solutions and residues for copper and iron.

The reaction, therefore, which actually takes place between ferrous sulphide and copper sulphate is this:

$$4\ FeS + CuSO_4 = Cu + FeSO_4 + Fe_3S_4$$

According to this reaction the residual mixture of sulphide or iron and precipitated copper would contain 17.7% copper. This was confirmed by analysis in every experiment and in no instance could the precipitation be increased beyond this point by boiling the solution or by long standing at ordinary temperatures. The precipitating value of iron matte, then, is 5.5 lb. of pure matte for each pound of copper precipitated.

SO_2 Fails to Increase Precipitation by Cupriferous Sulphide

The addition of sulphur dioxide to the copper solution failed to bring about a condition whereby the copper would precipitate as a sulphide, and cuprous-chloride solution confirmed the reaction by yielding twice as much metallic copper precipitate as cupric-sulphate solution. Ferric sulphate in the copper solution likewise had no influence on the reaction.

A series of experiments was also made by gradually increasing the acidity of the copper solution, by increments of 1%, until it contained 9% free sulphuric acid. This was, of course, beyond commercial limitations but the results were interesting. The experiments were made at ordinary temperatures and the standard acidified copper solutions were allowed to stand on weighed quantities of finely pulverized iron matte for 15 hr. Solutions containing about 5% free acid evolved some hydrogen sulphide when first added to the matte, but this evolution soon ceased. Little, if any, precipitated metallic copper could be noticed in the experiments containing more than 3% free acid but with all strengths of acid, substantially the same amount of copper was precipitated from each solution, as in the preceding experiments, which indicated that the foregoing reaction held true in acid solution but in addition, enough copper sulphide was precipitated by the hydrogen sulphide to mask the appearance of the metallic copper.

When crushed or granulated matte, about ⅛ in. in diameter was used for precipitation, until all action ceased, the outer coating of metallic copper could be removed from the particles of matte leaving a coherent, sooty nodule, of sulphide of iron, which, even when pulverized, had no further action on copper-sulphate solution but would yield hydrogen sulphide on heating with acid. The Fe_3S_4 formed was a stable sulphide.

Artificial Pyrrhotite Formation

Under certain conditions a reaction may take place, analogous to the above, which forms the mineral pyrrhotite, as seemed to be the case when an excess of copper-sulphate solution was allowed to stand on finely pulverized ferrous sulphide for a month at ordinary temperatures. Well formed crystals, having the appearance of pyrite or pyrrhotite, were undoubtedly formed, but they were small and I had no opportunity to examine them under the microscope.

The reaction in that case may have been:

$$6\ FeS + CuSO_4 = Cu + FeSO_4 + Fe_5S_6$$

or

$$8\ FeS + CuSO_4 = Cu + FeSO_4 + Fe_7S_8$$

Copper in matte, as shown in the preliminary experiments, has a tendency to prevent reaction between the ferrous-sulphide and copper solution. This I demonstrated further by a series of experiments in which the copper in the matte ranged from 0 to 33%.

In each test a weighed quantity of finely pulverized matte was boiled with standard 2% copper-sulphate solution for 20 to 60 min., or allowed to stand at ordinary temperatures for 20 to 24 hr., or both. After this, it was

found by experiment that no further action took place.

The standard copper solution was added in quantities to combine theoretically with all of the iron present in the matte as in the preceding experiments. Slightly acidifying the copper solution hastened the reaction a little and prevented the formation of basic copper salts without affecting the results.

The results were as follows:

Test number	1	2	3	4	5	6	7
Composition of matte:							
Per cent. Fe.....	65.0	64.2	60.4	56.4	52.8	48.3	38.0
Per cent. Cu.....	none	1.8	5.8	9.7	15.0	20.6	33.1
Per cent. copper precipitated from solution	22.4	20.0	10.7	13.7	5.8	7.4	4.4
Lb. iron dissolved per lb. copper precipitated	1.0	0.9	1.9	1.8	3.2	3.0	5.8

It will be noticed in Test 1 the straight iron matte precipitated about one-quarter of the theoretical amount of copper from solution in the manner explained in the preceding experiments, and approximately the theoretical amount of iron passed into solution for each unit of copper precipitated. As the copper contents of the matte increased, the percentage of copper precipitated from solution decreased, but the amount of iron passing into solution per unit of copper precipitated greatly increased. This phenomenon was also noticeable in the larger-scale experiments, and the only explanation I can offer is that copper-bearing mattes act as reducing and not precipitating agents, according to the following reaction:

$$FeS\ Cu_2S + 2\ CuSO_4 = Cu_2SO_4 + FeSO_4 + 2\ CuS$$

Excess of the precipitant or additional reducing reagents failed to precipitate the copper from solution.

The slight irregularities in the percentage of copper precipitated from solution, as shown by these experiments, as well as the slight amount of copper precipitated by the high copper mattes, I think are due to the irregular chemical composition of the matte and not to the precipitating qualities of either the iron or copper sulphides.

Matte is assumed to be, for all practical purposes, a mixture of FeS and Cu_2S, the lowest known sulphides of copper and iron. However, mattes are capable of dissolving metallic iron and copper and frequently contain more metals than can be combined with the sulphur in any known forms. When calculated according to the usually accepted combinations it will be found that ordinary copper matte contains an excess of iron, as metallic iron dissolved in the matte.[13] Therefore, the copper precipitated from solution by copper-bearing mattes is, in all probability due to the dissolved metallic iron in the matte and not to the matte itself.

This idea was suggestive so I endeavored to increase the precipitating power of an iron matte by making it dissolve as much metallic iron as possible and yet produce that iron in the matte itself, according to the following reaction, by stirring different percentages of iron oxide into molten matte.

$$3\ FeS + 2\ Fe_2O_3 = 7\ Fe + 3\ SO_2$$

The results were disappointing, for in no experiment did I get any increase in the precipitating power of the matte. However, by adding metallic iron to molten-iron matte I succeeded in getting nearly 30% of uncombined iron into the matte, which raised its precipitating value from 25% to 70% of the theoretical.

One more effort was made to reduce or control the speed of this reaction and if possible change the composition of the products formed and secure a higher precipitating efficiency from the matte.

Pure ferrous sulphide was cast into an electrode and connected with a platinum dish in such a manner that it would form a galvanic couple when the dish was filled with a solution of copper sulphate. On standing over night in this manner the copper was all precipitated from solution in metallic form; 52.5% of it was deposited on the ferrous-sulphide electrode and 47.5% was deposited on the platinum dish.

Carbon is just a little more electronegative than platinum, so standard copper-sulphate solution was passed through a tube containing alternate layers of granulated iron matte and coke, in contact and separated by diaphragms, but the results were not as good as with matte alone. Metallic copper was sometimes deposited on both coke and matte.

Gottschalk and Buehler[14] have determined the electromotive position of many of the mineral sulphides which might be of interest in the further study of this subject.

Use of the electric current in connection with ferrous sulphide failed to change its reaction with copper-sulphate solution.

Summary of Results

My experiments were made from a strictly commercial point of view and were governed necessarily by local conditions. As soon as they failed to come within these limits, or if qualitative results only were desired, further investigation was stopped, so that some portions of my work may seem incomplete.

Certain natural sulphides of iron, simple or complex, can be made to precipitate copper rapidly from its solutions, and under favorable conditions should be entirely feasible as a precipitant for copper, in hydrometallurgical processes, and also for any gold and silver in such solutions.

Other natural sulphides of iron do not act on solutions of copper, except very slowly—covering periods of months or even years; so there is no rule governing their precipitating value except that "Some do and some don't—you have to try them."

Artificial sulphides of iron containing more than 5% copper have slight precipitating power on copper solutions and are of no value for this purpose.

Pure iron sulphide or matte precipitates metallic copper from all solutions, and not cuprous or cupric sulphide as is generally supposed. The reaction is as follows:

$$4\ FeS + CuSO_4 = Cu + FeSO_4 + Fe_3S_4$$

The Fe_3S_4 formed has no further action on copper solutions, but on long standing in an excess of copper-sulphate solution it seems to have a tendency to polymerize and crystallize, probably into Fe_7S_8. Hydrogen sulphide is generated when Fe_3S_4 is treated with acid.

As seen by the reaction, only 25% of the iron passes into solution and is available as a precipitant. The highest-grade copper precipitate obtainable, therefore, from pure iron matte cannot contain more than 18% copper. It is doubtful if any conditions exist that would justify the production of matte for this purpose alone unless it carried high values in the precious metals.

[13] Peter's "Principles of Copper Smelting," pp. 401-428.

[14] Econ. Geol., Vol. 7, 1912, p. 15; Bull. 529, U. S. Geol. Surv., p. 51.

Notes on Mesabi Range Mining Practice--II.

By L. O. Kellogg*

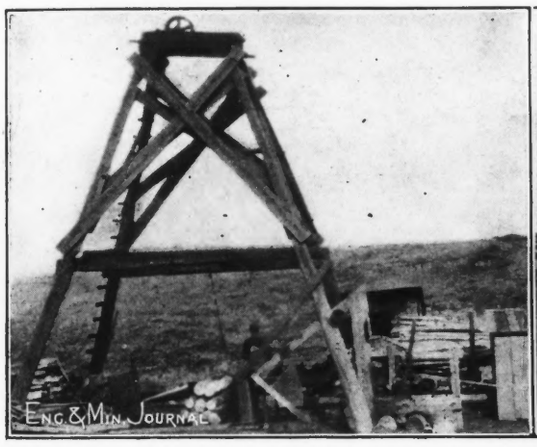
SYNOPSIS—Sinking and shaft linings. Boiler plants, pumping, tramming, skips, etc., are standardized. Considerable variation in types of headframes, buildings, hoists and shaft linings. Cages, compressors, infrequent and drill sharpeners rare. No provision for temporary storage in bins, but large-scale storage through the winter is practiced. A neglected opportunity for installing central generating plants. Great attention paid to safety measures. A long future for the district still assured.

Shaft linings of every type can be found on the Mesabi. The great reinforced-concrete monoliths of the Foundation company are equipped after completion with transverse steel supports for guides, etc. Ordinary open sets of 12x12-in. timber with wood lagging are still the lining most commonly seen. At one mine, the Bennett, they were dipped in Carbolineum before placing. Close cribbing is used in soft ground, as mentioned. Sets of structural steel are becoming increasingly common. Examples are the Leonidas shaft, using wood lagging and the new Hill Annex shaft near Calumet, using concrete slabs. A new development is the use of reinforced-concrete members throughout, sets and lagging, all cast on the surface and cured before placing. The Oliver company plans five new shafts for the winter of 1913-14, all to be lined in this manner. The pieces will be cast at a central plant in Hibbing and distributed as required. This will be the most enduring lining possible, but also the most expensive and the heaviest to handle. The exposed steel sets are said to rust and scale badly under certain conditions. Wood treated with preservative would appear to be the most economical in the long run but it does not eliminate the fire risk, although it does not increase it and may reduce it somewhat. An actual, though involuntary, test in the upper sets of the Bennett shaft showed that the dipped material burned less readily than the untreated guides.

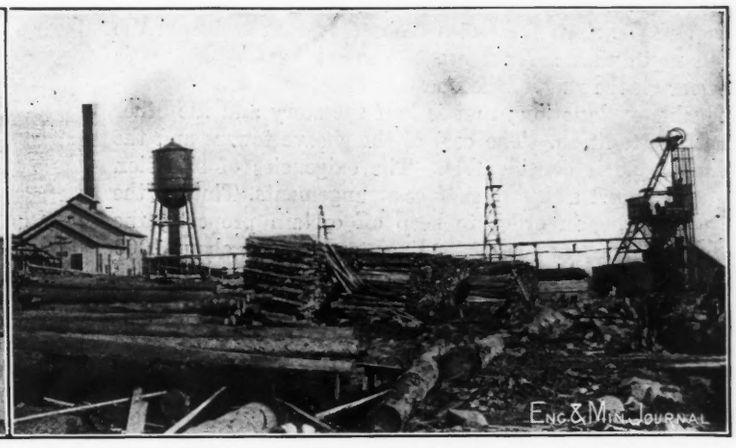
An interesting detail of sinking practice is the use of single-piece straight hanger bolts for timber sets, instead of the more common double bolts hooked together between the sets. They are stated to be stronger and no slower to handle. One may doubt the last assertion.

As much variety exists in the number and arrangement of the shaft compartments as in the linings. Two skipways and a combined manway and pipeway in a row is perhaps the most common form of shaft. A good many, however, are more nearly square and have a cage compartment across one end with the pipeway behind the skipways.

Some of the older shafts were put down as inclines on one side of the deposit. While various reasons for this are given, the real one seems to be that the old captains liked inclined shafts and did not understand the Kimberley skip.



A Typical Timber-Shaft Headframe



The Bennett Mine. Pin-Connected Headframe and Sheave Towers

Types of Headframes and Accessory Structures

Headframes of every description can be seen, ranging from old wooden towers to modern steel structures of the two-post type. The latter is now pretty well accepted as standard. A recent model, put out by the American Bridge Co., is perhaps the highest development and is giving excellent satisfaction. It is described as "pin-connected," all the principal joints being made with pins, held in by spring cotters, so that the structure may be rapidly dismantled into its separate members and taken to a new job. The design is carefully worked out and the metal well distributed and a remarkably stiff frame is obtained with a small weight of steel. One of the simplest and best looking headframes is that of the Morton mine, a heavy and sturdy steel structure. Posts, backstays and other main members of either an H-section built up of plates and angles or else of latticed channels are standard for the steel headframes, although some curious sections may be seen on those first erected, as at the Fayal. The old wooden towers are excellent examples of wasted material. They consist frequently of a

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lower tower of four to 12 posts, braced and counterbraced without limit, and on this, over the shaft, another smaller tower of four battered posts which carries the sheave. No backstays were originally provided but in some cases they have had to be applied.

The headframes are not of unusual height or weight, as they do not carry large bins or crushers. As on other iron ranges, a number of trestles are run out from every headframe at a point about 40 to 50 ft. above the ground, one for the waste dump, one for the tail of the stockpile tracks and one or more for the stockpile itself. The bents of these trestles may all be of wood but in many cases those which are near the shaft and are permanent, are of steel. Similarly to the other iron ranges, also, the hoist is kept far back from the shaft and a line of towers carrying idles sheaves is installed to support the rope over this interval. It is rare to see a hoist nearer the shaft than 300 ft. Various reasons are given for this practice: That it is unwise to place the hoist near the shaft on the unconsolidated glacial drift; that it is easier on the engine to have a pull more horizontal than vertical; that it is often necessary to keep the ground clear around the shaft for stockpiles and tracks; and even the old myth that a short arc of contact on the sheaves is easier on the rope. The question of room is the only reasonable explanation; that is half the story and the other half is tradition. The cost of the sheave towers and the extra rope is considerable. The exigencies of situation often compel awkward surface arrangements. Thus, at the Pettit mine, in order to keep off certain property, the ropes, as well as the steam lines, are carried about 1000 ft. over the surface. It may be stated in general that there is more rope on the surface than in the shaft of the ordinary mine.

Absence of Central Power Plants Remarkable

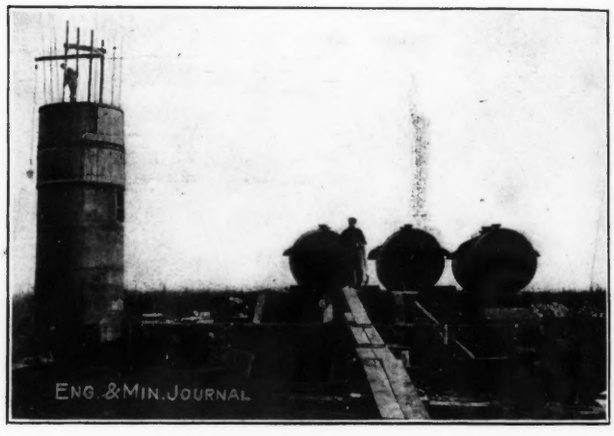
It is astonishing that no attempt has been made to establish central generating stations for the range. The field would seem to be ideal for a power concern to sell to the independent companies, while the Oliver and the larger independents could put in their own plants. There is still undeveloped water power in northern Minnesota, while even a central steam station, either at Duluth or on the range, would surely prove more economical than the hundred and more small, scattered plants. These are well enough designed for their class but they are not comparable in economy of operation with central electric stations. The life of the mines is long and can be closely foretold. The load is excellent in many ways. While there is no great amount of compressor capacity which could be driven with synchronous motors to produce a high power factor, the great pumping load should be capable of utilization in the same way. Hoisting is, of course, intermittent, but this has not been found serious in other mining districts. It would not be beyond the bounds of possibility to extend the electric service to the shovels and pit locomotives. The fact that operations are considerably slackened in winter is an unfavorable factor, but, nevertheless, the whole situation is as good as a power company expects and apparently an opportunity is being overlooked.

Character of Boiler Plants

The typical Mesabi power plant for an underground mine, comprises two or more return-tubular boilers and a feed-water heater with accessories. These are some exceptions: The Republic company uses marine boilers and reports them satisfactory; the same is true of the Morton mine; the Wisconsin Steel company for its washing plant put in Sterling boilers; the Oliver for some new small plants is putting in fire-box boilers of the locomotive or steam-shovel types. But even tho large plant of the Trout Lake concentrator uses return-tubular boilers. Stacks are of steel, brick and concrete, apparently about evenly divided.

Hoisting Not Standardized

There is nothing that can be termed a standard Mesabi hoist, the only points of similarity being that all are steam-actuated and that no reels are used. Every type of machine is represented, ranging from first-motion corliss engines with two clutched drums to slide-valve engines geared to one keyed drum. As a matter of fact little attention seems to be paid to hoisting practice, possibly because it is so easy, the deepest mines being shallow compared to other districts and no difficulty being encountered in getting to the surface all the ore that is



Beginning of Operations. Erecting Concrete Stack and Setting Fire-Tube Boilers at Hill Annex Mine

mined. There would seem to be no need for first-motion hoists for the depths of 150 to 300 ft. which prevail. There are some in service, however, as at the Morton and Scranton mines. Here greater depths will eventually be reached and the higher speeds of the first-motion hoists may be required. A common type of hoist consists of a slide-valve engine with two drums, driven through gearing, the crankshaft lying between the drum and the cylinders. This spreads out all over a hoist room and is unnecessarily big and expensive. Drums may be one or two and fixed or clutched. Usually hoisting is in balance and when only one drum is used the two ropes follow each other across the face of the drum. In few cases can hoists be seen which look as if they had been selected for the work in hand. Generally they have been brought from other properties, often from Michigan, and have led checkered careers. In one case an old corliss-engine, double-drum, geared hoist has been split to make two, the halves being locally known as "one-lungers." They would be quite impossible to operate, if the crankshafts did not have flywheels to carry over the centers. It takes a careful engineer to see that the same flywheels do not carry the skips over the sheaves. These hoists, however do not handle men.

The only new hoist seen that was clearly bought for the job is that at the Bennett. It was built by the Lake Shore Engine Works, has two 14¼x18-in. slide-valve cylinders, operating one 5x5-ft. drum through Wuest herringbone gears. It is strictly self-contained, the drum shaft lying between the crankshaft and the cylinders. The drum carries two ropes and is keyed to its shaft. The hoist is operating at present from a depth of 180 ft. but is capable of handling 400 ft. It is strong, compact, inexpensive, well built and well designed for its purpose, and may be taken as typical of what a Mesabi hoist ought to be.

Electric signaling is almost universal over the range, bells being used without flashes. It is customary for the men operating the stockpile motors to indicate their readiness to receive a skip of ore by switching on a light in front of the hoisting engineer, which remains burning as long as the motor and car are in position. At the Scranton mine, a double signaling system is used, the engineer repeating all signals before obeying, except of course the stop signal. Underground telephones are common.

The regulation skip is of the Kimberley type and holds 3 or 3½ tons. Larger skips are unnecessary, since, as stated, it is easy to take care of all the ore that can be got to the skip-pockets underground. For the same reason, auxiliary skip-loading pockets are not in general use, although they are found, at the Scranton, for instance. They are likely to become more common, the greater safety afforded to the skip-tender being urged in favor of their adoption.

Cages and Compressors Are Rare

Striking at first is the scarcity of compressors and cages. Cages are seldom necessary. The mines are so shallow that the men can use the ladderways without hardship. In fact, they voluntarily come out to eat in the middle of the day. There is no material but rock and ore to be handled and this is done in the skips entirely. There is little steel needed and the timber and other material is all lowered through small shafts, usually near the point where it is to be used. Some cages are found, as at the Scranton, Woodbridge, Schley and Leonidas mines. At the Leonidas the cage will be used for hoisting ore from a level serving a remote part of the mine above the main level. The Scranton cage is counterbalanced, the Schley works in a separate shaft and is also counterbalanced. The cages are of the large, well inclosed type general throughout the iron country.

The timber shafts are small, one- or two-compartment shafts, furnishing ventilation and facilitating the handling of the men, as well as affording a means of lowering material. Usually they are vertical, lined with vertical planking and equipped with small timber towers and stout windlasses. Sometimes they are inclined at such an angle as to permit the timber to slide freely but not too fast. The Bennett has such a shaft. It offers the advantage of allowing one man to handle the timber. The timber can be directed to any one of several levels by swinging deflecting boards down to the bottom of the slide. The ordinary mine will have one or more timber shafts situated at strategic points on the forty.

Since most of the underground drilling is in rock, no machines are commonly used. For this reason most of the shafts are not equipped with compressors. At others there are small machines of all makes and types. In some cases a large first-class machine furnishes air for a group of mines, as at the Spruce in Eveleth, where a compressor with a compound corliss steam end and two-stage air cylinders supplies the neighboring Oliver properties. This was the largest and best compressor seen on the range. The modified Jackhamer drill driving an auger bit is rapidly coming into favor for drilling in the ore and its adoption will necessitate the installation of more compressors. In many cases, compressed air is necessary for sinking and drifting and is got with small compressors temporarily installed. At the Harold a system of mining the rooms is being tried which involves the use of a Jeffrey air auger and a Sullivan air pick and compressed air is obtained from a Westinghouse air pump of the type installed on locomotives to supply the brakes. The same plan has been followed at the Vivian and Graham mines near Mesaba to supply the sinking drills. These small portable, cheap air pumps are excellent for such temporary installations.

Pumping is carried on altogether by steam direct and the Prescott practically has the field to itself. A good many of the old-style triple-expansion or compound slide-valve pumps are still in use but the standard is unquestionably the cross-compound, corliss, flywheel type. The pump rooms are well designed and present an excellent appearance. While the quantities of water handled are large, 3000 gal. per min. being common, the lifts are low, the water is not acid and is fairly clean so that there are no special difficulties to contend with. Some of the installations are enormous. At the Morton mines there is one triple-expansion 3000-gal. pump and one of 2000 gal., four compounds of 1000 gal. and four sinkers of 650 gal. beside smaller pumps for boiler supply, etc. This installation is not all in use at the same time, as the mine is making about 3500 gal. at present. On the other hand, at the Harold mine on higher ground about a mile distant, there is not enough water to supply the boilers.

Tramming Methods

Tramming on the sublevels is performed by hand. The ore is loaded from the sublevel chutes into cars on the main level and these are hauled usually by electric locomotive to the ore pocket at the shaft. At the Albany mine mules are still used and at the Morton compressed-air locomotives will be employed. The reason for this lies in the fact that the mine is exceedingly wet and the danger of electric short-circuiting and accidents is thus increased. A small high-pressure Ingersoll-Rand compressor is installed in the power house to supply the air to the locomotives.

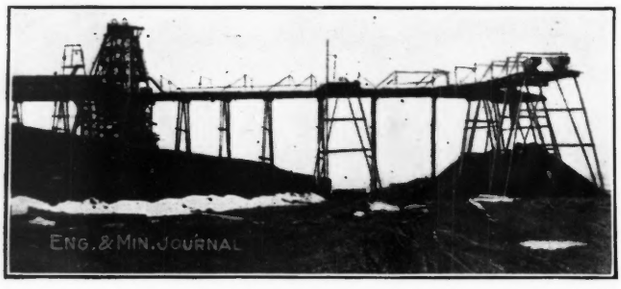
To take care of the lights, the underground motors and the stockpile motors one or two electrical units are included in almost every plant. Direct current of 250 volts is standard. In the plants generating electric power for the drying and washing plants a three-phase alternating current of higher voltage is generally used. There is no standard type of direct-current dynamo or engine. Practically every make of dynamo is represented and the engines include simple slide-valve, simple corliss, compound corliss and, at the Bennett and Schley, turbines. The drive is both direct and by belt.

It is noteworthy that there is practically no storage capacity in the mines or on the surface after the chutes

from the sublevels. The skip-pocket holds only a few trains of ore and there is little more than a chute in the headframes. As a result operations have to be rather closely synchronized, especially in winter when stockpiling is going on, and must be kept moving along smoothly, as they are. There is no mill to be kept going over Sunday and holidays but a boat waiting for a cargo at the Lake Superior docks is quite as insistent as any mill or smelting plant.

Stockpiling

If, however, there is no provision for storage over short periods of time, enormous quantities of ore are stored through the winter, as is general on the iron ranges. When the shipping season closes, stockpiling from the underground mines begins. The hoisted ore is dumped on a level spot near the shaft and the pile thus accumulated is usually shipped during the following summer but may be kept for several years. Shipment is effected by loading into the railroad cars with a steam shovel. The stockpile is generally started from the end of a short trestle, which clears the tracks and the immediate vicinity of the shaft. In this case end-dumping cars are used, each hauled by its own electric locomotive. The



Beginning to Stockpile

trestle may branch into several ends or the track may be branched on the surface of the pile after leaving the trestle. In either case a number of faces are kept moving forward and the pile thus extended. A variation on this method is followed at the Harold, Mississippi and Scranton mines, a trestle being built the full length of the pile in the first place and the ore run out in motor-hauled trains of several side-dump cars. After the trestle is filled, the track is swung to the sides, as on stripping dumps and the dump extended laterally in both directions. This promises to be somewhat cheaper than the older method. At the Shenango mine, single end-dump cars are handled with a wire rope by a small hoist.

Stockpiling, of course, is the direct result of the fact that traffic is impossible on the Lakes in the winter. The new steel plant at Duluth will probably take shipments all the year round but its capacity will be equivalent only to that of one or two underground mines. As a rule the openpits do not stockpile, but exceptions are found. Near the end of a lease, it may become necessary to speed up in order to get all the available ore, in which case shoveling may be continued through the winter and a large stockpile accumulated. This is the case at present with the Leonard and Alpena mines.

Almost every possible type of construction is used for the surface buildings, wood, brick, steel, concrete, etc. The change rooms in general present few features of interest. The best one seen is that at the Chisholm, built of concrete blocks and steel; the locker rows extend across the building so that good light is obtained; individual stationary basins are set along the side walls and showers and waterclosets are provided. A piece of land is usually reserved near each mine called the "location" on which residences for company employees are erected. These may accomodate practically all the mine employees or merely the staff. Water-supply and drainage are provided and low rents are charged. The openpits require rather elaborate machine shops for the repair of their locomotives and shovels; a roundhouse is, of course, necessary, and the whole plant is usually comparable with railroad shops in completeness and excellence.

Drill Sharpeners and Timber Framers

So far as known only two drill sharpeners are used on the range; there is a Numa at the Commodore and a Leyner at the Minorca. This is probably good practice; there are few mines whose drill consumption would justify the installation of a machine sharpener. With timber-framing machines the case is different. There is none in use anywhere, while the field for one would seem to be excellent. Hand-framing by contract, which is the system followed, is undoubtedly cheap but machine framing should be cheaper and certainly better.

A great deal of attention is paid to safety measures; machinery moving parts are protected by netting or railing; first-aid outfits are kept in readiness and drills held. In the new change houses it is customary to provide an emergency room, which is kept warmed, contains a cot and is supplied with bandages, etc. Warnings are posted where dangerous conditions exist and rules are formulated and enforced. The result in the last few years is stated to be a great decrease in the accident and death rate.

The statement is often made that mining will be carried on in this, that or the other district when the Mesabi is dead and forgotten. Possibly, but the Mesabi resources seem too great to justify predictions as to their limitations. The limits of the district in depth and horizontally are pretty well defined but great orebodies still remain untouched, such as those owned in fee by the mining companies and those under lakes and bad surface. Furthermore, beneficiation processes, especially washing and drying, are bringing into the class of merchantable ores, great tonnages heretofore unavailable. It is a safe assertion that no other iron-mining district in the United States will ever add so great a total to the nation's wealth or return so great a profit to its exploiters.

Nickel-Matte Analyses

Some nickel-matte analyses, taken from A. P. Coleman's "The Nickel Industry," which show the typical concentration of the rare platinum metals, are given herewith:

	Murray Mine Bessemer Matte	Ringerike Norway	Evje Norway
Ni }	48.82%	51.16%	41.50%
Co }		1.98%	0.97%
Cu	25.92%	16.40%	23.00%
Fe	2.94%	10.87%	.....
S	22.50%	19.58%	.....
Au	0.02 oz.	0.0145 oz.	0.029
Ag	3.14 oz.	2.46 oz.	4.06
Pt	0.13 oz.	0.075 oz.	0.09
Ir	0.02 oz. }	0.03 oz.	.....
Os	0.02 oz. }		
Rh, Pd	tr oz. }		

Calculation of Strike and Dip

By Theodore Simons*

SYNOPSIS—Simple trigonometric and algebraic development of formulas for determining the strike and dip of an inclined plane, such as a vein, when drilling and surveying have definitely located three points in the plane. A numerical example worked out and a graphical solution also given.

Prospecting for beds and veins of ore by means of bore-holes is a method offering so many advantages that its use in exploration work is becoming more and more common. This fact calls for simple means by which the strike and dip of such deposits may be readily determined from the depth of the holes and from the data obtained by survey. For many practical purposes, simple graphical solutions give sufficiently accurate results. It is possible, however, to develop formulas equally simple which will serve to check the graphical solutions and *vice versa.*

We know that three points in space, not in the same right line; one right line and one point outside of the line; or two intersecting right lines, define a plane in space having a definite strike and dip. Fig. 1 illustrates graphically the meaning of these terms. The strike of an inclined plane, such as an ore vein, is the line of intersection of that plane with an imaginary horizontal plane. It is, therefore, any horizontal line in that plane. The dip of the plane, that is, the angle of inclination, is the smaller of the two angles included between a line in the horizontal plane, drawn at right angles to the strike and a line in the inclined plane, drawn at right angles to the strike at the same point. To fix the plane positively in space, the direction of dip must be given as well as the angle or amount of dip. Standing at some point of the inclined plane and looking down to a lower point in the same plane, one is looking in the general direction of the dip. The exact bearing of this direction is obtained by remembering that the line of dip forms a right angle with the strike.

If a number of bore-holes have been driven to explore a vein and to establish its strike and dip, they may be grouped into series of three holes each, since three points in space determine a plane. The results obtained from each series are combined by averaging or by any other method that local conditions may suggest.

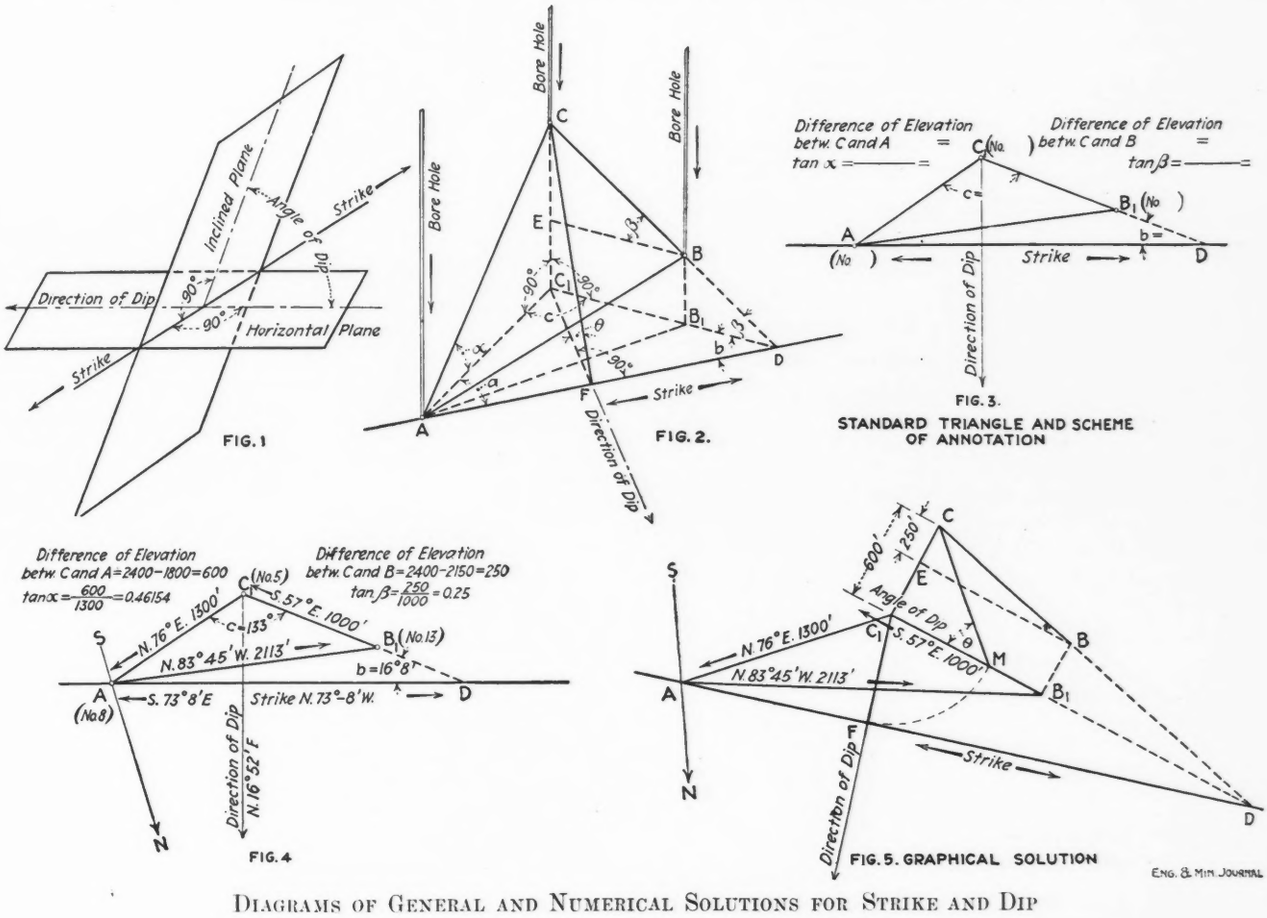


FIG. 1. FIG. 2. FIG. 3. STANDARD TRIANGLE AND SCHEME OF ANNOTATION

FIG. 4. FIG. 5. GRAPHICAL SOLUTION

Diagrams of General and Numerical Solutions for Strike and Dip

Determination of Strike

Let *A, B, C,* Fig. 2, be the points at which three vertical holes pierce the vein that is being prospected. *A, B* and *C* may, of course, be three points reached by any

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other method of development, such as a shaft or drift. If we lay a horizontal plane $A\,C_1D$ through the point which happens to have the lowest elevation (in this case A), and if we extend the line connecting the highest point C with the next lower B, until it pierces at D the horizontal plane $A\,C_1\,D$, then the line $A\,D$ is the line of intersection of the inclined plane laid through the points A, B, C, with the horizontal plane $A\,C_1\,D$. According to definition, the line $A\,D$ is the strike of the inclined plane $A\,C\,B$.

If we now project the point C vertically upon the horizontal plane to a point C_1, and connect the latter with points A and D, respectively, we get two vertical right-angle triangles $C\,C_1\,A$ and $C\,C_1\,D$ and a horizontal triangle $A\,C_1\,D$, which we may assume to be an oblique triangle.

In triangle $C\,C_1\,A$ we have $C\,C_1 = C_1\,A \tan \alpha$ and in $C\,C_1\,D$ we have $C\,C_1 = C_1\,D \tan \beta$; whence, $C_1\,A \tan \alpha = C_1\,D \tan \beta$; or, $\dfrac{\tan \alpha}{\tan \beta} = \dfrac{C_1D}{C_1A}$, and since $\dfrac{C_1D}{C_1A} = \dfrac{\sin a}{\sin b}$ we have

$$\frac{tan\ \alpha}{tan\ \beta} = \frac{sin\ a}{sin\ b} \qquad (1)$$

This is an exceedingly useful formula to remember, since it affords a quick solution of countless other mining problems.

From the preceding operation we have learned that if two intersecting lines in space are cut by a horizontal plane, a line connecting the points where these lines pierce the horizontal plane is the strike of the plane laid through the intersecting lines.

The law, expressed in equation (1) may be stated as follows: The tangent of the angle of inclination of line No. 1 is to the tangent of the angle of inclination of line No. 2, as the sine of the angle formed by the strike and the horizontal projection of line No. 1 is to the sine of the angle formed by the strike and the horizontal projection of line No. 2.

In mine problems the angle of inclination of a shaft, a winze, a tunnel, or any kind of opening is the angle included between the opening and its horizontal projection. The quantity $\dfrac{\tan \alpha}{\tan \beta}$ in equation (1) is always known from the survey; thus $\tan \alpha = \dfrac{C\,C_1}{C_1\,A}$, in which $C\,C_1$ = the difference of elevation between points C and A and $C_1\,A$ = the horizontal distance between C and A, as obtained by survey; while in, $\tan \beta = \dfrac{C\,E}{E\,B}$, $C\,E$ = the difference of elevation between C and B and $E\,B$ = the horizontal distance between C and B, obtained by survey.

We will call

$$\frac{tan\ \alpha}{tan\ \beta} = m \qquad (2)$$

In the horizontal triangle $A\,C_1\,D$ the sum of the angles $a + b + c = 180°$, whence $a + b = 180° - c$; $(180° - c)$ is always known, since c is the angle included between two lines the bearings of which are known from survey. Calling this quantity n, we can write:

$$180° - c = n \qquad (3)$$

Whence,

$$a = n - b \qquad (4)$$

Substituting m from equation (2) and value a from equation (4) in equation (1), we get $m = \dfrac{\sin\ (n - b)}{\sin\ b}$; or, $m \sin b = \sin n \cos b - \sin b \cos n$; or $\sin b\ (m + \cos n) = \sin n \cos b$.

Whence,

$$tan\ b = \frac{sin\ n}{m + cos\ n} \qquad (5)$$

Having found angle b, the bearing of the strike, line $A\,D$, is obtained by combining angle b with the bearing of line $C_1\,D$ known from survey. Thus the solution of such a three-point problem resolves itself into the solution of the three simple and easily remembered equations (2), (3) and (5).

Determination of Angle and Direction of Dip

Referring to the definition given, the angle of dip is the angle θ in Fig. 2, obtained by drawing line $C_1\,F$ perpendicular to the strike and connecting F and C. Applying equation (1), modified to correspond to the angle of dip, we have $\dfrac{\tan \theta}{\tan \beta} = \dfrac{\sin 90°}{\sin b}$.

Whence,

$$tan\ \theta = \frac{tan\ \beta}{sin\ b} \qquad (6)$$

The direction of the dip can always be found by inspection of the diagram, Fig. 2. Its exact bearing is the bearing of a line at right angle to the strike.

Uniform Terminology

When solving a series of numerical problems all of the same type, time and confusion may be saved by adopting a standard pattern of solution. In this three-point problem, for instance, certain letters may be made always to designate the same conditions, thus:

A = The point having the lowest elevation;
B = The point having the next higher elevation;
C = The point having the highest elevation;
B_1 = Projection of B upon horizontal plane laid through A;
C_1 = Projection of C upon horizontal plane, laid through A;
a = The angle of inclination of line connecting the highest with the lowest point;
β = The angle of inclination of line connecting the highest with the next lower point;
c = The horizontal angle included between the above lines;
b = The angle included between the line of strike and the extension of the horizontal projection of the line connecting C and B;
θ = Angle of dip;
$m = \dfrac{tan\ a}{tan\ \beta}$;
$n = 180° - c$.

Any oblique triangle, Fig. 3, will then serve as a pattern on which the data obtained from survey and calculation are marked off. It is advisable to indicate all directions by an arrow, also to draw a north line through one of the points.

Numerical Example

From a series of vertical holes, driven to explore a vein of ore, Nos. 5, 8 and 13 have been selected to determine

the strike and dip of the vein within the area embraced by these holes.

A surface survey has furnished the following data: Elevation of top of hole No. 5, 2500 ft. above datum; of hole No. 8, 2100 ft.; of hole No. 13, 2450 ft.

Depth of hole No. 5 from surface to vein, 100 ft.; of hole No. 8, 300 ft.; of hole No. 13, 300 ft.

Bearing of line 5-8, N 76° E.

Horizontal length of line 5-8, 1300 ft.

Bearing of line 8-13, N 83° 45′ W.

Horizontal length of line 8-13, 2113 ft.

Bearing of line 13-5, S 57° E.

Horizontal length of line 13-5, 1000 ft.

Desired: (1) The strike of the vein; (2) the direction of the dip; (3) the angle of dip.

The elevations of the hole bottoms are calculated to be 2400 ft., 1800 ft., and 2150 ft., respectively.

In our standard triangle, Fig. 4, following the scheme of Fig. 3, point A now represents the bottom of hole No. 8 and point B_1 is the projection of the bottom of hole No. 13 upon the horizontal plane laid through A, while C_1 is the projection of the bottom of hole No. 5 upon the same plane.

From equation (2) $m = \dfrac{\tan \alpha}{\tan \beta} = \dfrac{0.46154}{0.25} = 1.84616$, while from equation (3) $n = 180° - 133° = 47°$, and from equation (5) $\tan b = \dfrac{\sin n}{m + \cos n} = \dfrac{\sin 47°}{1.84616 + \cos 47°}$ whence $b = 16° 8'$

Combining angle b with bearing of line $C_1 B_1$, gives for bearing of strike $A D$: S 73° 8′ E.

From Fig. 4 the direction of dip is found to be N 16° 52′ E, and from equation (6), $\tan \theta = \dfrac{\tan \beta}{\sin b} = \dfrac{0.25}{\sin 16° 8'}$ whence $\theta = 41° 59'$.

In Fig. 5 a method of graphical solution is shown. Plot triangle $A C_1 B_1$ from survey notes; at C_1 erect a perpendicular to $C_1 B_1$, equal to the difference of elevation between C and A (600 ft.); on this line measure off $C E$, equal to the difference of elevation between C and B (250 ft.); through E draw a line $E B$, parallel and equal to $C_1 B_1$; connect C with B and produce connecting line to its intersection with the extension of line $C_1 B_1$ at D; draw $C_1 F$ perpendicular to $A D$ and on $C_1 B_1$ lay off $C_1 M$, equal to $C_1 F$; connect C and M. On this diagram the bearing of the strike and dip and the angle of dip may be taken off by means of a protractor.

Dunderland Iron Ore Co.

SPECIAL CORRESPONDENCE

The new manager, Mr. Bannatyne, arrived in Dunderland on Feb. 27, and work will be proceeded with immediately. The machinery, which has already been ordered, will, it is hoped, be installed in August, and regular operations commenced in May, next year. For the time being, briquetting will not be resorted to. Ullrich's wet process, for which Krupp holds the patent, has been adopted for a small provisional treatment of 500 tons of crude ore a day. Among the original shareholders, $625,000 has been subscribed for this purpose, and in the event of the success of the trial future operations on a large scale will be again resorted to. These mines were shut down in 1908, chiefly owing to dust troubles caused by the dry process of separation then employed. A disadvantage with the ores, apart from their quartzy nature, is the large proportion of iron glance, 2½ to 3 times that of the magnetite proportion. The Fe content is about 36%, and the reserves of ore available for opencast quarrying are computed at 110 to 120,000,000 tons.

Experiment with Falling Bodies in a Deep Mine Shaft

The Michigan College of Mines, Houghton, Mich., has made some tests of falling bodies in a deep vertical shaft of a copper mine at Calumet, Mich., according to the M. C. M. press bulletin. Within a radius of a mile from Calumet are three of the deepest shafts in the world, one of them being 5300 ft. deep. One of the experiments consisted in dropping a smooth metal ball two inches in diameter from the center of the shaft and trying to catch it in a box of clay placed 4200 ft. beneath. Another ball was dropped from the southwest corner of the shaft. The balls were dropped by burning threads by which they were suspended so that they started to fall without any lateral motion. The shaft is 9x30 ft. in cross-section. The first of the balls was suspended four feet from the side of the shaft and the second from a point nine feet from the opposite corner. Neither of the balls reached the box of clay; one of them was never found and the other, presumably the one started from the center, was found by a workman lodged in the timbers on the east side of the shaft 800 ft. from the surface.

Bodies dropped into the shaft invariably lodge somewhere in the east wall. This action takes place because the earth is rotating on its axis from west to east. At Calumet a particle at the surface is moving to the east at the rate of about 1000 ft. per sec.; but a particle 5000 ft. down the shaft, having the same angular velocity as the particle on the surface, is moving eastward at a rate of four inches less than 1000 ft. per sec. The ball suspended at the top of the shaft had a 1000-ft.-per-sec. velocity; it was not only moving eastward at that rate when it started to fall, but continued moving eastward all the way down the shaft. Meanwhile, it dropped to the bottom at a rate which would have taken 17½ sec. for the fall, if there had been no air resistance to encounter. During the 17½ sec., the particle at the surface and the ball falling at the same rate would have traveled 17½ times four inches, or nearly six feet further eastward than the particle at the bottom of the shaft. The ball started from the center of the shaft, therefore, struck the east wall long before it reached the bottom. As a matter of fact, the resistance of the air at the high speed the ball acquired soon after starting, was sufficient to prevent any further acceleration and consequently the ball was much longer than 17½ sec. in falling. In fact, only 800 ft. of fall was required for the ball to make the four feet from the center of the shaft to the east wall and the other ball must have lodged at some point not much further down.

If the walls of the shaft were smooth and free from obstructions, no doubt a falling body would rebound from side to side of the shaft and finally reach bottom, but the many timbers in the lining of the shaft and the levels all the way down furnish places where a body is sure to

lodge, and so if a load of ore were to be spilled into the shaft near the top most of it would later be found clinging to the shaft or stranded on the levels east of the shaft.

[We remembered that R. M. Catlin, of the New Jersey Zinc Co., had once spoken of an experience of his, corroborative of the above deduction. He supplied the following description of the incident.—EDITOR.]

An accident occurred at the shaft of the Simmer & Jack West, when the shaft was something over 2000 ft. deep. I was passing the shaft one day and saw a loaded bucket, containing 16 cu.ft. of rock, go into the sheaves, break away and fall down the vertical shaft. At the time there were 52 boys and one white man at the bottom. I called the hospital at once and as soon as we were able to do so, rigged a new bucket and started down. At a depth of less than 200 ft. we found the bucket balanced on the timbers. Securing this we proceeded below and were astonished to find that no one below had received the slightest injury. The shaft was 8x28 ft. in the clear and it is evident no considerable amount of rock could have come down, when it is considered the number of individuals huddled together there. The white man in charge said that a while before they noticed a "bit of dust," as he expressed it, in the shaft, but no rocks appeared to have fallen. The shaft was timbered its entire depth to within about 100 ft. of the bottom, affording lodgments of a width of 8 in. and the contents of the bucket had been distributed along the timbers. Probably no large pieces happened to be in this bucket, only such as could lodge on a 8-in. ledge.

Norwegian Copper Mines

SPECIAL CORRESPONDENCE

A 55-years' lease, followed by non-compensatory expropriation, has been granted by the state to a company—presumably foreign—for the operating of the well known Aamdal copper mines. They are situated in Telemarken, Norway, about a day's journey by steamer and horse conveyance from the town of Skien on the southeast coast. Numerous British companies, including the Tharsis, have, during the last 50 years, exploited these mines with, on the whole, negative results. The ore, a bornite, originally described as of 20% content, has seldom within the last 15 years exceeded that percentage, even when concentrated. To this drawback, there had to be added a horse-haulage to the neighboring Bandak lake, of $1.56 per ton of concentrates, followed by two transhipments, canal dues, and oversea freight to South Wales. There are, however, a number of promising occurrences outside the boundary of the old workings, which, with the installation of aërial transport to the lake, may give new life to the mines. They date from the seventeenth century, and are of such extent underground that, apart from the inacessible older workings, a period of seven days is necessary for a conscientious inspection of their ramifications.

The main level was driven in on the Hoffnung lode for a distance of a mile—when the lode petered out. The parallel Howard lode has a lower-grade ore, which, though increasing with depth and persisting along the east and west drives, does not improve in assay. It is questionable whether the average, including that of the ore still available in some maiden ground of the Hoffnung and its small, if rich, satellite vein, the Parallel lode, will exceed 3%. The camp, which lies away in a mountain valley, some 15 km. from the outside world, has, or had, a good compressed-air service, for drilling and other purposes, an uptodate sorting, crushing, and dressing equipment, an Elmore mill, a large residence for the manager, grocery stores, offices, schoolhouse, doctor's residence and some 60 houses for the accomodation of the men.

During the earlier part of January, the thermometer at Röraas, in Norway, registered a record of —50° C. This reading is only 10° above the minimum noted by Amundsen at the South Pole. The number of men employed in these mines in 1913 was 570, and the output from the smelters, 556 tons of copper. The pyrites output was about 12,000 tons.

The Cote-Pierron Electric Zinc-Smelting Process

According to European technical papers, the Côte-Pierron electric-smelting process is in use at a works at Ugine, Savoy. The fundamental reaction employed in this process is the decomposition of zinc sulphide by metallic iron. According to *Berg- und Hüttenmannische Bundschau,* Jan. 20, 1914, which apparently derives its information from other papers, the furnace at Ugine is rated at 400 kw. It is a cylinder lined with masonry, having an internal diameter of 2.25 m. and a depth of 1.10 m. The bottom of the furnace forms one electrode. The opposite electrode passes through the roof. Alternating current of 52 to 56 volts is used. Charges of 300 kg., ore and iron, are introduced every two hours.

A part of the zinc is collected in the first condenser, along with mechanically carried impurities (such as silica and lime). The vapor then filters through a coke column, heated by the vapor itself, where the greater part of the zinc is condensed.

About 75% of the zinc of the ore is obtained. In 72 hr. the furnace smelted 9560 kg. of blende, assaying 34.8% zinc, mixed with 2970 kg. of iron. The electric energy used measured 16,285 kw.-hr. The spelter product was 2800 kg., assaying 99.06%. The iron sulphide and the slag amounted to 9730 kg., averaging 1.85% zinc. The electrode consumption was 110 kilograms.

The daily duty of this furnace is reckoned at 3200 kg. of ore and the use of 1700 kw.-hr. per ton. The furnace is attended by two men. The cost of treating a ton of 34-38% ore is reckoned at about 40 marks ($9.52). The cost of plant is computed at about 15,000 marks ($3570) per ton of metal produced per 24 hours.

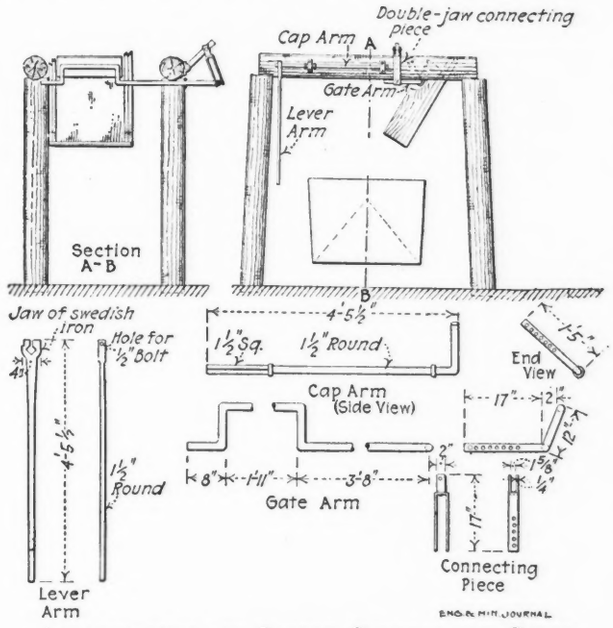
[The figures herein given relate to tons of 1000 kg. Reduced to tons of 2000 lb., the estimated power consumption is 1542 kw.-hr. per ton, electrode consumption 23 lb., and cost of smelting $8.63 per ton. Apparently it is considered that the iron-sulphide product can be sold as a sulphur ore. The smelting of one ton of blende of the composition stated required about 0.31 ton of iron. Assuming that the furnace is manned in eight-hour shifts, the smelting of one ton of ore requires about two-man days. The estimated plant cost figures out to about $3.30 per metric ton of annual capacity in terms of ore. a figure so low that there must be some mistake about it. EDITOR.]

Details of Practical Mining

Safety Lever for Arc Gate

By E. W. R. Butcher*

In its effort to reduce accidents, the Republic Iron & Steel Co. has introduced among numerous safety devices an operating lever for the underground arc-type chute gates. A drawing showing details and arrangement is presented herewith. Usually such a lever arm is attached directly to a trunnion of the gate. The arm extends across the drift and where motors are used, it is necessary for the man emptying the chute to stand between the cars. In this position, he is likely to be caught between the car and the arm should the train move unexpectedly. Furthermore, while, as a rule, the chute man is required to remove the arm when the chute is emptied,



Arrangement for Safely Controlling Chute Gates

if he fails to do so it is likely to strike anyone riding past on the motor, and to cause a serious accident.

With the device here shown, the lever arm is on the side of the drift, making it unnecessary for the chute man to stand between the cars and largely doing away with the danger of accident. The ends of the gate arm, of the cap arm and of the double-jaw connecting piece are fitted with several connecting holes by which the arms can be adjusted to the positions which permit the most satisfactory operation. Placing the connecting end of the gate arm in a horizontal position or at a slight angle above the horizontal and the connecting piece of the cap arm at 45°, gives the best results. The ends of the connecting arms are made round and the holes in them are made a little larger than the holding pins, so as to prevent binding.

The measurements given are for a chute 30 in. wide in a drift 7 ft. wide. The main dimensions can be easily changed to suit any ordinary width of chute or drift.

*Engineer, Republic Iron & Steel Co., Gilbert, Minn.

Hammer vs. Piston Drills

In the Washington mine, at Oxford Furnace, N. J., the ore is stoped by the underhand method, a 3¼-in. piston machine being used, and all holes drilled being down holes. At the Mt. Hope mine, at Mt. Hope, N. J., the shrinkage system of stoping has been adopted. The holes are all uppers and drilling is done with a 1¾-in. hammer drill. The ore in both mines is magnetite, occurring between walls of gneiss. At the Washington, the vein is from 15 to 40 ft. wide, averages about 57% in metallic iron and dips at an angle of 55°. The ore contains about 3% of sulphur, in the form of iron pyrites. At the Mt. Hope mine, the different orebodies vary from 6 to 20 ft. in width, the dip is about 70°, and the ore contains no pyrites, the percentage of metallic iron varying from 35 to 55%. The Washington ore is harder than the Mt. Hope, but this greater hardness is offset by the tendency of holes at Mt. Hope to fitcher. In both mines the ore breaks badly.

Taking everything into consideration, drilling conditions at the two mines are about equal. The class of labor, the wages, and the hours of work at the properties, are alike. An objection may be raised that the operations of the two classes of drills are being compared under different methods of stoping, but such objection is not justified, since the cost per foot drilled does not depend to any great extent on the method of stoping.

The costs of stope drilling during 1912 were as follows, in cents per ton of ore:

	Washington Mine (Piston Drills)	Mt. Hope Mine (Hammer Drills)
Drilling	22.5c.	15.3c.
Repairs	1.4	2.4
Miscellaneous	2.4	1.2
Sharpening	1.5	1.9
Power	8.5	7.8
	36.3c.	28.6c.

Included in "drilling" are charges for steel, air hose, air pipe, etc. At the Washington mine 23.7 ft. was drilled, and 24.5 tons of ore were broken per drill-shift. At the Mt. Hope, the figures were 33.3 ft., and 23.7 tons.

For the first eight months of 1913, the costs were, per ton:

	Washington	Mt. Hope
Drilling	21.3c.	14.6c.
Repairs	1.9	2.2
Miscellaneous	0.3	0.4
Sharpening	2.6	1.3
Power	3.8	5.4
	29.9c.	23.9c.

During this period, at the Washington, 24.5 ft. was drilled, and 25.8 tons broken per drill-shift. At the Mt. Hope, the figures were 31 ft., and 28 tons.

For 1912, the difference in cost for drilling opera-

Note—Excerpt from M. M. S. A. Bull. No. 68, discussion by W. B. Devereux, Jr.

tions was 7.7c. per ton in favor of the hammer drill; for 1913, the difference in the cost of drill operations was 6c. per ton in favor of the hammer drill. The decrease in the difference is due entirely to the fact that during 1913 the power cost at the Washington mine was greatly reduced through utilizing waste gases from the blast furnaces to generate power. This amounted to a decrease of 4.7c. per ton in power charges for drilling at that mine.

The average of the drilling charges per ton cited is 33.1c. at the Washington, and 25.7c. at the Mt. Hope. The footage per drill-shift at the Washington was 24.1 and the average ore broken was 25.1 tons. At the Mt. Hope the figures were 32.1 ft., and 25.8 tons.

From these figures, the cost per foot of hole drilled, was 35.4c. at the Washington, and 20.65c. at the Mt. Hope, a difference of 14.75c. per foot in favor of the hammer drill.

At the Melones mine, in California, however, after a careful test of both drills, the hammer was discarded in favor of the piston. The orebody there is wide, about 70 ft., and the rock is hard to drill, but breaks easily. Holes up to 14 ft. deep are drilled, and from 20 to 30 holes are put in before a round is fired. About two years ago, hammer drills were tried, but it was found that they could not drill the long holes at all, nor could they drill so fast as the piston.

The great advantage of the hammer drill over the piston is that only one man is required to operate it. A quicker set-up can be made, and the drill is easier to carry from one part of a mine to another. The disadvantages are generally considered to be: (1) The dust; (2) the necessity that the operator rotate the drill by hand.

The question of dust is probably exaggerated. Hammer drills have commonly been used for overhead holes, which it is impossible to wet unless some mechanical spray is used. This applies equally to the piston drill. The great objection to the hammer drill on the part of the miner is that it is too hard to rotate. The last complaint may possibly be eliminated in the future by the use of a self-rotating hammer drill.

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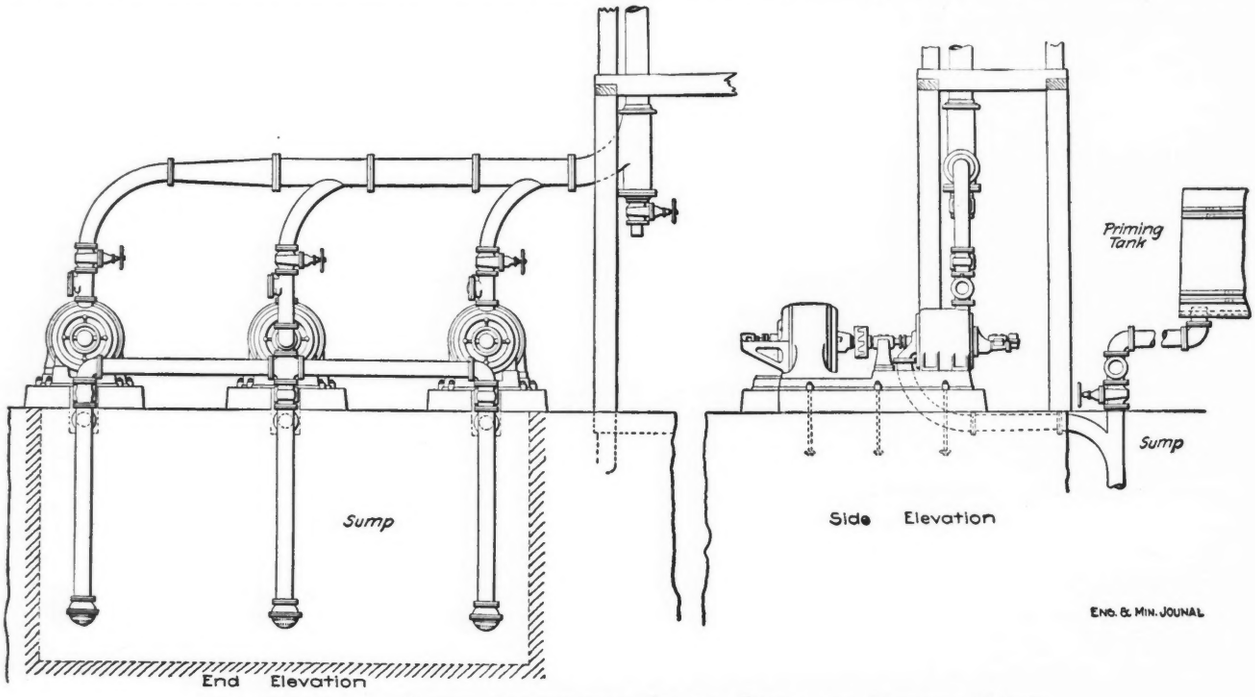
Pump Layout for La Palmilla Mine

By T. G. Hawkins, Jr.*

The accompanying drawing will serve to show the general layout of the proposed pump station for the 8th level of La Palmilla mine, property of the Alvarado Mining & Milling Co. of Parral. These plans were submitted and accepted in 1910, and the pumps and necessary equipment were ordered and received shortly before the outbreak of the first Mexican revolution.

During the latter part of 1909, while sinking the main shaft, a heavy flow of water was encountered 185 ft. below the 6th level, making it necessary to sink against 900 gal. per min., more than could be handled at that time with the sinking equipment; the water, therefore, after a short while, was allowed to rise to the 6th level, the lowest level of the mine.



Arrangement of Three Centrifugal Pumps, Sump and Priming Tanks

On this level a 6-in., four-stage Buffalo centrifugal, motor-driven station pump had been handling from 800 to 1100 gal. per min. for about one year, and had given excellent results. This pump is shown on the drawing as pump No. 1, and with two new ones would complete a three-unit plant as shown. Pumps Nos. 2 and 3 are equipped with 15-in. runbacks for their motors in case it is desired to open them up for inspection. They will work under a head of 345 ft., discharging at the 4th level main adit.

The pumps were manufactured by the Buffalo Steam Pump Co., Buffalo, N. Y., are equipped with General Electric synchronous motors of 160 hp. each, and run at

*Superintendent Veta Colorado mines of the Alvarado Mining & Milling Co., Parral, Chih., Mexico.

a speed of 1200 r.p.m. They have each a capacity of 1000 gal. per min. under a head of 375 ft.

The priming tank is kept full by a small valve leading from the 13-in. water column and insures priming in case the water column has been drained for any purpose.

Before the last two pumps were received the company purchased all the mines belonging to the Hidalgo Mining Co., and it was decided to await the arrival of power from a hydro-electric plant under construction on the Conchos River, about 40 miles distant, before undertaking the unwatering and developing the lower levels of the Palmilla, since at the time sinking was stopped, the mine was making 1200 gal. per min., and still more was to be expected upon opening up new workings below.

In the meanwhile, these pumps are being used elsewhere. The running elements of one of them were altered and the pump is now delivering 1400 gal. per min. under a head of 142 ft.; another was altered to deliver 800 gal. per min. under a head of 635 ft.; while still another was altered to handle 1000 gal. per min. under a head of 500 ft. In no case was the speed of the motor changed.

Conveyor Belts for Distributing Filling

The North mine at Broken Hill was already partly developed on the 800-ft. level when the present management faced the problem of providing an efficient distributing systm for filling. Above that level reserves did not

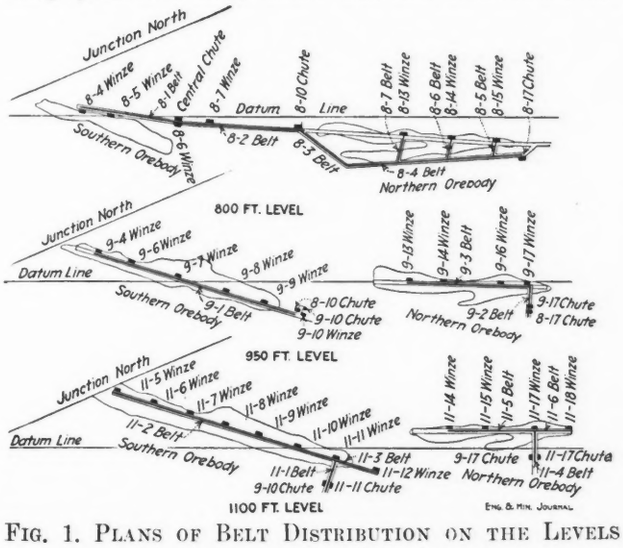


FIG. 1. PLANS OF BELT DISTRIBUTION ON THE LEVELS

warrant the heavy cost of installing a system to fit in with the mine lay-out then existing. The distribution of filling is here still effected by means of tramming.

The filling consists of residues from the concentrating mill. The main channels for its gravity run consist of three chutes. These are carried down outside the limits of the orebodies, and the filling is conveyed from them on the different levels to the various winzes in the orebodies themselves. A complete distribution of the filling is made to every winze on each successive level, the practice of passing filling from level to level through working stopes being in no place adopted. The advantages of this are many, the chief being that in no place are stoping operations hindered on account of filling operations, and *vice versa*.

Of the three chutes, the central extends from the surface to the 800-ft. level, and is continued below that level only in the form of a winze, which enters the orebody a

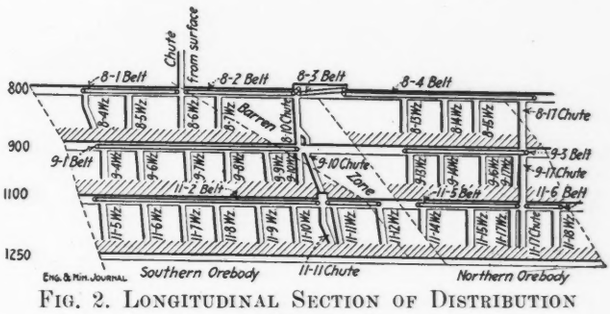


FIG. 2. LONGITUDINAL SECTION OF DISTRIBUTION SYSTEM

short distance below the level, the filling is passed into the stopes off this winze by a direct gravity run from the surface. This chute is situated in the hanging wall of the lode, but down to the 800-ft. level is opposite a barren zone between the two orebodies being worked. The northern limit of the southern of the two orebodies lies just opposite this chute on the 800-ft. level, and to carry the chute down in the hanging might lead to a serious interruption of filling operations should any movement occur in the hanging wall.

A transfer is made on this level to the two other chutes situated 350 ft. and 1000 ft. respectively north of the first chute. Of these the first, 8-10 (Figs. 1 and 2), is carried from the hanging wall side of the lode on the 800-

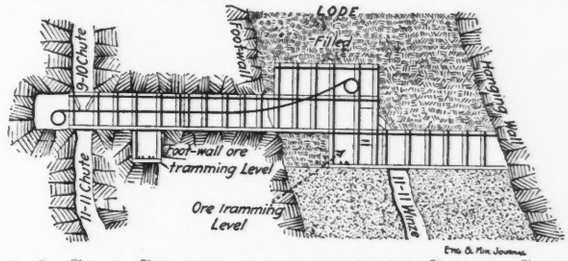


FIG. 3. CROSS-SECTION THROUGH 11-11 CHUTE, SHOWING SEPARATION OF BELT AND TRAMMING SYSTEMS

ft. level through the barren zone referred to, into footwall country at the 1100-ft. level, and below that level will continue in this safe quarter. The second, 8-17, is entirely in footwall country below the 800-ft. level. This transfer of the main chutes into footwall country places the filling operations in a thoroughly safe condition.

The transfer of the filling from the central chute to 8-10 chute is effected by means of 8-2 belt, from which filling is also removed into 8-7 winze in passing. The delivery end of this belt is raised so as to deliver on to 8-3 belt, which transfers the filling materials through the barren zone in the lode-channel to 8-4 belt. A temporary chute from which filling was trammed for some time was installed at this transfer station. The crosscut containing 8-3 belt is carried over the tramming levels, thus keeping the two operations quite clear of each other. The 8-3 belt delivers to 8-4 belt, which in turn delivers into 8-17 chute. Short subsidiary belts, 8-5, 8-6 and 8-7, take the filling material from 8-4 belt at different points,

Note—An abstract of a paper by W. C. Gall, "Proc. Aust. Inst. of Min. Eng.," No. 10, 1913.

each delivering into a separate winze in the orebody. From the chute, 8-1 belt delivers into two winzes to the south.

On the 950-ft. level in the southern section, the filling from 8-10 chute takes three courses, viz., into 9-10 chute, into a winze directly under the chute into stopes below, and to 9-1 belt, which feeds five winzes to the south. In the northern section, filling from 8-17 chute is delivered directly into 9-17 chute, as well as to 9-2 cross belt, which delivers both into a winze in the orebody and also to 9-3 belt, which in turn feeds three winzes south of the chute.

On the 1100-ft. level in the southern section, 9-10 chute delivers into 11-11 chute, and also to 11-1 belt, which crossing into the orebody, feeds both into a winze, and on to belts 11-2 and 11-3, which feed six winzes south, and one north of the cross-belt respectively. A similar arrangement is provided for in the northern section, and also on the next lower level. A cross-section through the 1100-ft. level (Fig. 3) showing 11-1 belt, illustrates the typical arrangement of transfer from the footwall into the orebody, and the manner of keeping clear of ore-tramming operations.

The belts are motor-driven, with a reduction belt drive to a countershaft and a further reduction to suitable speed of driving pulley by gearing. The width of the belt used is 18 in. The belts are run on day shift only, sufficient filling being delivered where required to last through the two following shifts. Colored lights with switches at intervals are provided as a means of signalling to the feed attendant in the event of a change of feed being required. Filling is removed at intermediate winzes by means of rubber scrapers set diagonally across the belt, two being used at each winze; the first removing the bulk of the filling, while the second cleans the belt. When possible the latter is not used and the belt is allowed to deliver a small amount into the end winze, thus reducing the wear on the belt.

Wood and Mortar Powder Magazine

A magazine for the storing of explosives should be neighborhood-proof, fireproof, moisture-proof, bullet-proof and rat-proof. A neighborhood-proof magazine is one that in case of an explosion does not scatter its débris over the neighborhood, destroying property and life; and to be neighborhood-proof a magazine should be entirely surrounded by a mound of earth, so that should an explosion occur, its force will be deflected upward and not directed on buildings in the vicinity; the material used should be such as will not be projected beyond the site of the magazine.

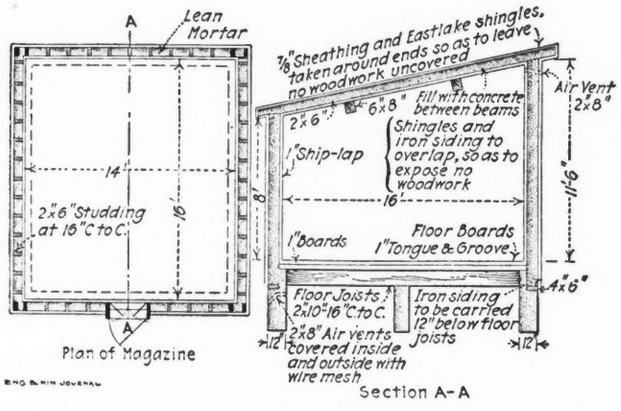
To be moisture-proof, a magazine should have a roof to shed rain, be built in a dry and well drained situation, be so ventilated that the inside will not retain moisture and be constructed of material which is, to the highest degree obtainable, nonabsorbent of water.

To be bullet-proof, the door and roof as well as the sides should not be easily penetrated by a bullet. The expression "not easily penetrated," is employed advisedly; for with a modern rifle, while it is not impossible, it may be impracticable to make a magazine absolutely bullet-proof.

The mentioned desiderata are obtained in the construction of a powder magazine, described in the Can. Min. Inst. *Transactions* for 1913, of which a detailed description is here presented.

A bend in a ravine on the property furnished natural mounds and a dry location with drainage. The foundation walls, extending well into the ground, were built of concrete. In these were laid the floor joists flush with the foundation top; 2x6-in. stuff was used for side-studding and roof rafters. Studding and rafters were lined inside and out with 1-in. ship-lap, and the space between filled with a mortar consisting of one part cement to five parts sand. A floor of 1-in. boards and 1-in. flooring was nailed to the joists.

The door was a double one of iron, of the type used on fireproof vaults, but with a key lock instead of a combination. The roof of the building was covered with galvanized Eastlake shingles and galvanized iron siding was used, extending down over the foundation walls and completely covering the entire building, so that no portion of the woodwork was exposed.



POWDER MAGAZINE OF WOOD, SHEET IRON AND LEAN MORTAR

Ventilation was secured by openings through the concrete walls both below the floor and above it; these openings were built diagonally, contained a turn and were covered inside and out with a fine wire mesh.

The inside of the building was made fireproof by several coats of whitewash on the sides and ceiling, and fireproof paint on the floor. It was thought better to have the inside finished thus, as the explosive stored was mostly black powder in kegs and it was necessary to avoid the possibility of the sparking of the kegs, or of nails in the boxes containing other explosives, against a surface of iron, cement, brick or stone.

The lean mortar filling was designed to disintegrate in case of an explosion, and, being lined on both sides with iron and wood, it was considered more likely to be thrown down than scattered. The cost of the magazine was $642.

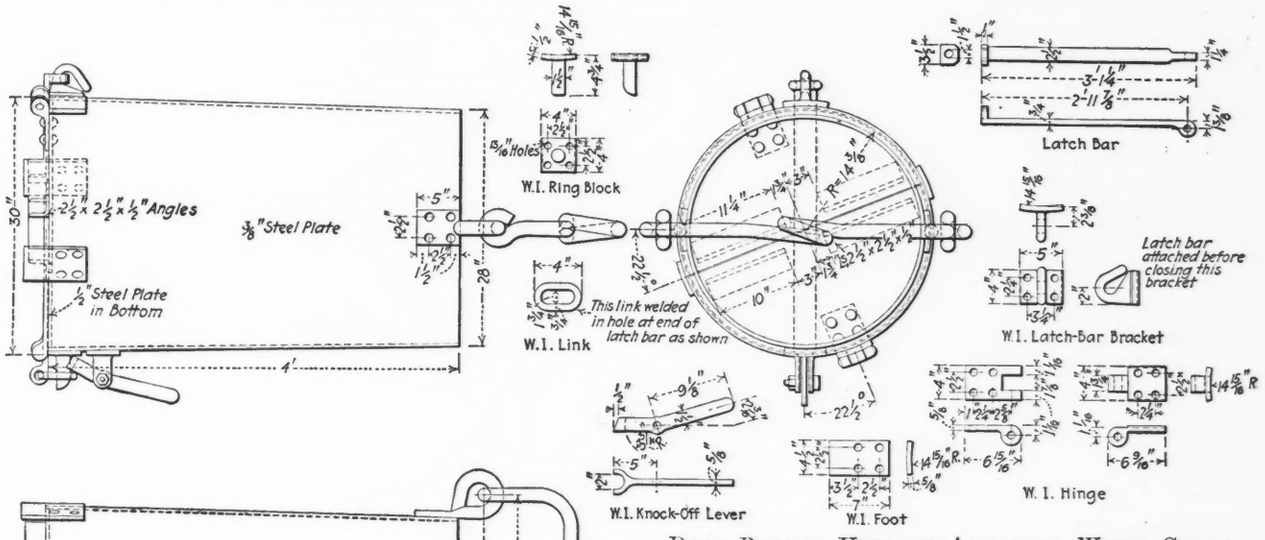
Four Switches Must Be Successively Closed on the blasting circuit before the shots can be set off in the electric-firing system installed by the Meyer & Charlton on the Rand ("Journ." Chem., Met. & Min. Soc. of South Africa, October, 1913). The keys giving access to these switches are in the possession of certain responsible individuals. Further safety precautions are the use of lamps to indicate when the current is on for each level, gates which are locked to prohibit entrance to the level when the firing connections have been made, and telephones by which the blast on each level can be heard at the surface.

Details of Milling and Smelting

Dope Buckets for Converters

When the two electric traveling cranes in the converting department at Anaconda were overtaxed and the third crane not yet installed, it was decided to help out the other two cranes by installing between each two converter stands a swinging jib crane, from which was suspended a bucket that could be filled with "dope" or flux, moved into a position over the converter mouth and opened by the converter attendants, without any help from the cranes.

The bucket and jib crane were shown in the view of the converter aisle at Anaconda on p. 518 of the JOURNAL, of



DOPE BUCKET USED AT ANACONDA WHEN CRANE SERVICE WAS INADEQUATE

Mar. 7, 1914. The details of the bucket itself are shown in the accompanying engraving. The bucket is 4 ft. deep, and has a special latch at the bottom, by striking the trigger of which the contents of the bucket are permitted to drop into the converter. The bucket is not cylindrical as would appear at first glance; its diameter at the top is 28 in. and at the bottom 30 in., thus facilitating the discharge of the contents. It is made of ⅜-in. steel plate, but the bottom doors are of ½-in. plate. The bale is of 1½-in. round iron, and the latch bar if of ¾x2½-in. material. The bottom doors are semicircular, hinged at opposite sides of the bucket, and braced by 2½x2½x½-in. angles. The details of the latch and other parts will be readily understood from the accompanying drawing. When the third traveling crane was installed, these buckets were no longer necessary, as the crane service was then sufficient to permit the use of the long, narrow boats which could be more easily loaded.

*

Prevention of Clinkering

Where a coal clinkers badly on account of the silica and the bases being nearly balanced, the fusing point of these impurities can be raised by adding to the fire more bases, such as limestone, magnesia rock or oyster shells (*Power*, Feb. 24, 1914). Numerous schemes have been tried by firemen and engineers to prevent clinkers and considerable improvement has been made in late years in burning coal in boiler furnaces, especially in the use of the finer sizes and the refuse coals, or culms.

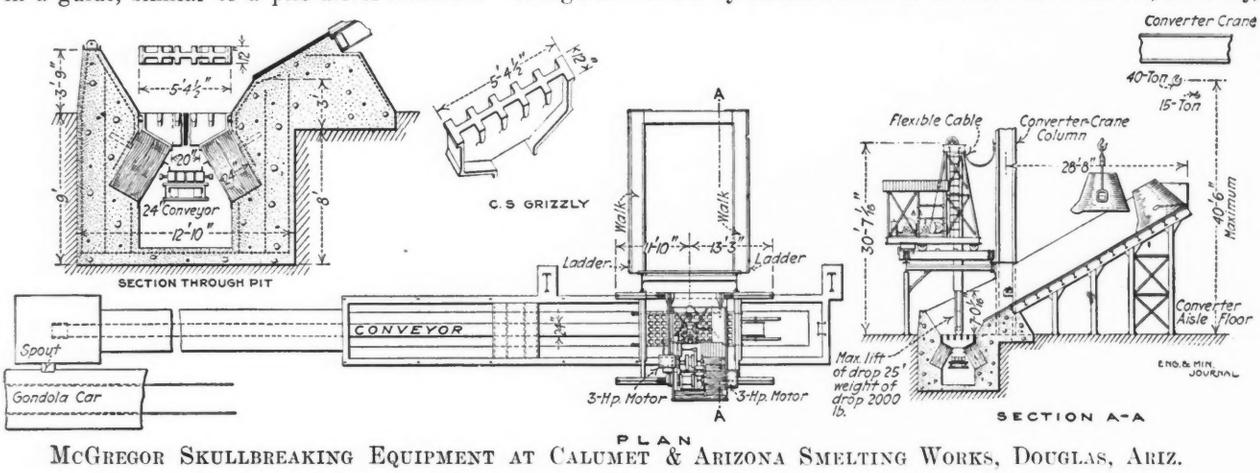
One of the first clinker preventives tried on this class of fuel was the steam blower. Its virtue lies in its cooling action on the fire bed, for with some coals the higher the temperature of the fuel bed the greater the tendency to clinker. In starting the fire, plenty of kindling should be used so as to make an evenly distributed fire and one that is brought up slowly. An ash bed is thus formed and kept over the entire grate. Any clinkers formed, even if small, should be removed when first cleaning the fire, as these little clinkers shield small areas of the fuel from the air blast and the clinkers continue to grow. The air distribution must be uniform. Late practice reduces the air space, as much as 50% in some types of furnace, and increases the blast. The effect of this system where properly installed and operated has been remarkable. The high velocity of the blast through $\frac{1}{16}$-in. holes with 3-in. blast in a Dutch-oven furnace produces an intense furnace temperature. Under these conditions, it is possible to keep a white heat in the furnace and at the same time have the grates free of clinker, and this, too, when burning a refuse coal.

The McGregor Skullbreaker

The accompanying views show the McGregor skullbreaker, as installed at the Calumet & Arizona Mining Co.'s new smelting plant, at Douglas, Ariz., where it has been highly satisfactory and may be said to represent the highest development yet attained in the disposal of slag skulls of the modern converting plant. The skullbreaker was devised and patented by A. G. McGregor, of the firm of Repath & McGregor, engineers, Douglas, Arizona.

An inclined chute or bin is provided, into which the skulls from the slag ladles are dumped directly by the crane. At the lower end of the inclined chute is a grizzly made up of a number of cast-steel units, as shown in the illustration, so that a floor having 9-in.-square openings is obtained. The base of the grizzly forms a hopper; the material passes through the openings to a 24-in. steel-pan conveyor. The conveyor carries the material up an incline, delivering it into a chute which discharges into a 60-ton steel ore car.

The slag skulls that do not pass through the grizzly are broken into fragments by a 2000-lb. weight, working in a guide, similar to a pile-driver hammer. The guide



McGregor Skullbreaking Equipment at Calumet & Arizona Smelting Works, Douglas, Ariz.

for the weight and an electric hoist for raising the weight are supported from a trolley which has cross-travel over a short bridge. The bridge in turn has a transverse travel over a short runway, so that the hammer can be spotted over any portion of the grizzly. To break a large skull, the operator spots the trolley in position; the hammer or weight is raised to any height up to 25 ft., and drops when the hoist drum is released. It can be raised and allowed to fall as many times as is necessary, usually only a few blows are required to break a solid skull. As fast as the fragments are made small enough to pass through the grizzly, they drop on the conveyor and delivered into the railroad car. In other installations, where conditions permit, the railroad cars will be placed directly under the grizzly and the conveyor dispensed with. In such installations, the cars will be handled up and down the incline by means of a rope from the second drum of the skullbreaker hoist and suitable tackle connections.

The trolley and bridge travel are accomplished by means of small electric motors operated from controllers in the operator's cab of the trolley. The weight is of comparatively small cross-sectional area and 11 ft. long, so that it always remains in the guide. The electric hoist is provided with two drums. One is narrow and light, having as little inertia as possible to oppose the falling weight. The other drum is large and has a long cable wound on it; this passes out through a snatch block attached to the side of the pocket below, and is used for spotting cars under the chute at the end of the conveyor. The machine has a capacity of approximately 50 tons of ordinary skulls per hour.

At the Calumet & Arizona plant the breaker is used only in the forenoon, as a rule. When it is not working, a beam is placed between the columns at the sides of the inclined chute, which prevents the hot skulls containing molten slag from being emptied on the grizzly, and molten slag from running on the conveyor when the latter is not moving. In the morning when ready to start breaking skulls, the converter crane is used to lift the beam out of the way, permitting the cold skulls to slide down where they can be broken to pass the grizzly.

Extraction of Silver at the Nipissing Mill

Extraction of silver at the Nipissing mill, Cobalt, is noted by James Johnston in *Bull.* A. I. M. E., January, 1914. The ore is all treated as slime in mechanical agitation tanks which are also equipped with an air lift, 6 in. in diameter. The accompanying table represents the average extraction obtained from 54-oz. silver ore, in the combined metallurgy of the high-grade and low-grade mills.

	Heads per Ton, Oz.	Total Silver, Oz.	Extraction	Average Residue per Ton, Oz.	Total Residue, Oz.
79 tons.....	2648.47	209,229	99%	26.48	2,092.29
7230 tons.....	26.00	190,320	92%	2.08	15,225.60
399 tons.....	54	.....	95.66%	2.34	.....

To this recovery is to be added a further saving of 85% of the silver, obtained by the sale of the 26.48-oz. residues, containing 8% to 9% of cobalt, which is also paid for. In the high-grade ore, containing nearly 3000 oz. silver, only about 4 oz. is not reclaimed.

Smelting Smoke Is Considered a Blessing in Chile, according to T. T. Read (M. M. S. A., Bull. No. 68). The Société des Mines de Cuivre de Catemou, east of Valparaiso, owns and operates ranches and vineyards, in order to keep down the cost of high living. The vines were attacked by the phylloxera and were about to die, when the plant was blown in. It was then found that the sulphur dioxide served as an excellent disinfectant of the vines, which have flourished ever since. That is probably the only place known where it is capable of proof that smelting smoke is a benefit to agriculture.

The Assayer and Chemist

The Dehydration and Recovery of Silica

The question of the dehydration and recovery of silica in the analysis of the silicates has just been reinvestigated by F. A. Gooch, F. C. Reckert and S. B. Kuzirian (*Am. Journ. Sci.*, December, 1913). It is the general opinion that blast-lamp temperatures are necessary to obtain a constant weight for anhydrous silica, but this has been found unnecessary for silica from the hydrolysis of silicon tetrafluoride. Moreover, it has recently been shown that precipitated silica may be brought to constant weight by prolonged ignition over a bunsen burner, thus avoiding the danger of the loss of platinum which ensues on prolonged blast-lamp ignition. Three hours is mentioned as the minimum period requisite.

It appears from the author's work that the difficulty of bringing precipitated silica to constant weight does not lie in the dehydration, but in impurities which must be volatilized and made to enter into stable combination with the silica. These proved to be sodium chloride and sodium sulphate, which can both be removed by sufficiently long ignition over a bunsen burner, except for some Na_2O, which forms sodium silicate. If, after such heating over a bunsen burner, the silica be treated with hydrofluoric acid, the residue remaining is mainly Na_2SO_4, from which the Na_2O equivalent should be calculated and deducted from the previously ascertained weight of silica.

It was also ascertained in the course of these experiments that when a sodium-carbonate fusion is acidified with hydrochloric acid and evaporated, that no number of such treatments will recover all the silica except the silica first thrown down be filtered off and the residue reëvaporated. The deficiency, where the attempt is made to get all the silica off in a single filtration, may amount to as much as 5 mg. in 0.5 gram, an amount of commercial importance.

Magnesite Crucibles

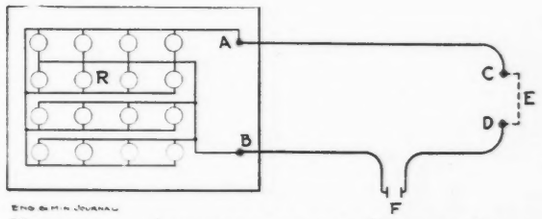
By Donald M. Liddell*

Apparently the article on magnesite crucibles in the Journal of Sept. 13, 1913, has been misunderstood by some readers. These crucibles are not of foundry size. For instance, the largest stock size handled by Eimer & Amend, which has begun the importation of a fine line made by the Deutsche Gold & Silver Scheide Anstalt, is 120x120 mm., with a capacity of 580 c.c. In addition to importing these crucibles, some of the smaller sizes are usually carried in stock. Larger sizes can be made to order, but it sometimes takes nine months or over, to secure delivery. The Wilson-Maeulen company, mentioned in our earlier article, also reports that it is anxious to turn over this business to Eimer & Amend.

If large-size magnesite-lined crucibles are needed, it seems desirable to turn out homemade ones as directed in the Journal of Sept. 13, 1913, or as outlined by Frederick Cohen, in the Journal of Jan. 24, 1914.

An Efficient Method for Cutting Glass

There is often difficulty in satisfactorily cutting glass in the laboratory, and this is especially true in the case of glassware of large diameter says J. I. Hardy (*Journ. Ind. and Eng. Chem.*, March, 1914). There are several methods in common use. Probably the fine flame of the blowpipe applied upon a file scratch is one of the best known methods. The diamond point is often used with satisfaction. A metal rod may be bent to the shape of the object to be cut, heated red hot, and passed over the surface on the line where the glass is to be cut, then if the glass is plunged into water it will separate on this line of contact.



Electrical Arrangement for Cutting Glass

The writer believes the following method to be capable of wide application, and that the desired results can be rapidly and efficiently obtained in the average laboratory. The equipment consists of an electric system giving at least 6 amp. electric current, a resistance apparatus consisting of a rheostat or a bank of 12 lamps (16 cp.) arranged in parallel, and a piece of No. 24 nickel-chromium wire. When long tubing is to be cut, a steady rest will prove helpful and can be arranged to suit the convenience of the operator.

Bind a piece of wire around the glassware, twisting the ends together and making sure that the wire follows the line where the glass is to be cut. This wire serves only as a guide, and may be of any inexpensive material. In the diagram, *R* indicates the bank of lamps, which is used on account of being both inexpensive and easily adjusted to definite resistance. At binding posts *A* and *B* connection is made with the electric-light system of the building. Between *C* and *D* is inserted the No. 24 nickel-chromium resistance wire *E*, and *F* is the switch.

After the lamps *R* are loosened sufficiently to break their connection, the switch at *F* is turned on, and the lamps are screwed in one at a time until the wire *E* is a dull red. The glassware which has been prepared with guide wire is given a slight file scratch of about ¼-in. length on the line to be followed in cutting,

*Associate editor, "Engineering and Mining Journal."

and is brought into the loop *E* and revolved two or three times, holding the nickel-chromium wire close to the metal guide. After the glassware has been revolved two or three times in the loop *E* more lamps are connected in the bank *R* until the wire *E* is a bright red. Now the wire loop *E* is held in contact with the file scratch for a few seconds until a crack is started. The glassware is now revolved, keeping the heated wire slightly ahead of the crack until the glass is cut off. If the wire cools it may be released slightly from the glass until it regains its heat.

This method is effective and can be used to cut any kind of glass from cheap bottle glass to the best Jena. It will work successfully on glassware with cylindrical, spherical or conical walls, and will cut the glass in any direction in which the guide is placed.

Determination of Arsenic with Hypophosphorous Acid and Iodine

The precipitation of arsenic in the elementary form by means of hypophosphorous acid and its subsequent determination iodometrically, can be conducted in relatively large quantities of liquid and without a condenser (*Journ. Soc. Chem. Ind.*, 1914, p. 28). On dissolving the precipitate in iodine solution, then adding bicarbonate and titrating in presence of starch, the total iodine consumption is 10I for 2As. The arsenic can also be determined by adding a mixture of potassium iodide and iodate to the precipitate and titrating the iodine liberated. The reactions are as follows:

$2\,As + 6\,I + 3\,H_2O = As_2O_3 + 6\,HI$, and then $6\,HI + KIO_3 = 3\,H_2O + KI + 6\,I$, and $6\,H_3AsO_3 + 5\,KI + KIO_3 = 6\,KH_2AsO_3 + 6\,I + 3\,H_2O$, one atom of arsenic being equivalent to one atom of iodine. This method is more rapid than the other, and nearly as accurate. On comparing the results of the precipitation and distillation methods, it is found that the latter gives less exact results. Some of the reasons for this have been described previously (*Journ. Soc. Chem. Ind.*, 1909, p. 1169), and it is also found that the presence of small quantities of higher oxides of manganese in iron ores affects the distillation. The method is also suitable for the determination of arsenic in pyrites.

Combustion Analysis with Tellurium Oxide

At a red-heat, tellurium oxide becomes a mobile, heavy fluid, with a strongly oxidizing effect on many not otherwise easily attackable bodies. It is thereby partially reduced to metallic tellurium which floats on the melt in glistening globules. If the oxidation product is a gas, for example, carbon dioxide from elementary carbon, carbides, cyanamide and so on, or nitrogen from nitrides, cyanamides, etc., it can be estimated according to known methods. Tellurium dioxide, and also metallic tellurium, is itself so slightly volatile, that its effect on the absorption of the gases to be estimated presents no difficulty. As the molten tellurium dioxide, which for such analyses may be employed in excess, is a good solvent for non-volatile basic reaction products, its use is indicated for quantitatively carrying out combustions for many estimations of carbon and nitrogen, possibly also of sulphur in substances otherwise rather difficult to treat. R. Glauser states in the *Chemiker-Zeitung* that he has carried out combustions with tellurium dioxide for the estimation of nitrogen in aluminum nitride, of carbon and nitrogen in calcium cyanamide, of carbon in ferrochrome, and also of carbon in hard steels which can only be ground with the greatest difficulty, but large lumps of which dissolve easily in the molten dioxide. The results of his analyses were in close agreement with those obtained using the recognized methods, and the saving of time effected was considerable. There is no difficulty in recovering the greater part of the used tellurium.

Iron-Ore Analysis

The report of the Verein Deutscher Chemiker upon the analysis and sampling of iron ores is abstracted in the *Journal of the Society of Chemical Industry*, Feb. 16, 1914, p. 138.

SAMPLING—The sample, which should be fairly finely ground and not exceed about 50 grams, is emptied in a heap upon paper, and divided into two parts with a spatula. One part is pressed out with a broad spatula, the other part is sprinkled on to the layer thus obtained, and the whole mass then pressed out in the same way. This treatment is repeated 20 times, the final heap being pressed flat with a glass plate and divided into sections with a quadrant. The two parts opposite each other are united to form one sample, the original thus giving two representative samples.

IRON—Five grams of each of the samples are moistened with 1 to 2 c.c. of water in a 400- or 500-c.c. Erlenmeyer flask, 100 c.c. of hydrochloric acid (sp. gr. 1.19) added, and the flask covered with a watch glass and heated for three hours at 60° C. The liquid is then boiled to expel chlorine, diluted with 150 c.c. of water and filtered into a 500 c.c. flask. The residue is ignited, and fused with sodium bicarbonate, the melt dissolved in dilute hydrochloric acid, the iron oxidized and precipitated with sodium hydroxide, the precipitate washed and dissolved in hydrochloric acid, and the solution added to the main solution. Or the residue may be treated with hydrofluoric acid and sulphuric acid, and dissolved in hydrochloric acid before the precipitation of the iron.

Residues from ores containing chromium are fused in a nickel crucible with sodium peroxide and sodium carbonate, the melt dissolved in hot water and filtered, and the residue of iron oxide dissolved in hydrochloric acid (1:3) and added to the main solution. The united solutions are made up to 500 c.c., and 100 c.c. of the liquid concentrated to 50 c.c., reduced with hot concentrated stannous chloride solution (an excess of 1 or 2 drops being given), then thoroughly cooled and treated with 25 c.c. of a 5% solution of mercuric chloride. After 2 minutes the liquid is poured into 2 liters of water containing 60 c.c. of manganese sulphate-phosphoric acid solution (200 grams of manganese sulphate per liter treated with a mixture of 1000 c.c. of phosphoric acid of sp.gr. 1.3, 600 c.c. of water, and 400 c.c. of sulphuric acid of sp.gr. 1.84) with sufficient permanganate solution to give a pink coloration. The iron is then titrated with potassium permanganate solution (about 6 grams per liter), which has been standardized upon pure iron oxide. In the case of ores containing copper the results for iron are not so accurate, but separation of the copper effects no improvement.

Company Reports

Tamarack

According to the annual report of the Tamarack Mining Co., Calumet, Mich., for year ended Dec. 31, 1913, expenditures were $49,923 more than receipts. The company now has a balance of $1,070,938 in quick assets, of which $563,700 is represented by stock holdings in the Hancock & Calumet and the Mineral Range railroads and Lake Superior Smelting Co. All mining operations have been discontinued on account of the strike and it is stated the mine will not open again until a good force of competent miners can be secured. A summary of production for eight years follows:

PRODUCTION

Year Ended Dec. 31	Tons of Ore Treated	Average Yield Lb. Cu	Lb. Cu Produced	Net Cost per Lb. of Cu, c.
1906	389,680	25.3	9,832,644	14.7
1907	533,600	20.8	11,078,604	16.5
1908	654,897	19.6	12,806,127	15.2
1909	689,099	19.6	13,533,207	14.1
1910	525,554	21.1	11,063,606	14.4
1911	392,338	19.1	7,494,077	15.4
1912	421,385	18.8	7,908,745	13.15
1913	227,563	18.3	4,168,743	16.60

Not including $770,315 received in 1909 from the sale of lands, the company's profits and dividends have been:

PROFITS AND DIVIDENDS

Year Ended Dec. 31	Profits	Loss	Dividends Paid
1906	$413,990	.....	$300,000
1907	.....	$9,277	420,000
1908	.....	235,606	.....
1909	.....	128,546	.....
1910	.....	166,348	.....
1911	.....	201,173	.....
1912	269,612	.....	.....
1913	.....	49,923	.....

There were 230,677 tons of rock hoisted from the mine during 1913, of which 3114 tons, or 1.3%, were discarded as waste. The total depth of the Tamarack shafts are as follows: Shaft No. 1, 3049 ft.; shaft No. 2, 4355 ft.; shaft No. 3, 5253 ft.; shaft No. 4, 4450 ft.; shaft No. 5, 5308.5 ft. from the surface. No. 3 inclined shaft is 220 ft. below the 202 level.

It is estimated that a total profit of about $5,000,000 can be made by treating the sand tailings in Torch Lake. Leaching will be a part of the process used in treating these sands.

Mexico Mines of El Oro

The annual report of the Mexico Mines of El Oro, El Oro, Mexico, shows a balance of $932,566 from operations in its annual report for the year ended June 30, 1913. The mill treated 158,395 tons of ore having an assay value of $8.23 in gold and $3.61 in silver. The actual recovery was 88.99% of gold and silver contents, or 92.04% of gold and 82.02% of the silver. The total cost of production was about $4.55 per ton of ore treated, made up as follows: mining, $1.30; development, 82c.; milling, 22c.; cyaniding, 97c.; general expenses, 46c.; and current construction, head-office expenses, income taxes, etc., not given in statement of costs, about 43c. per ton. Development work totaled 8140 ft. exclusive of shaft sinking. Shaft sinking consisted of connecting the North shaft with the eighth and ninth levels, or 163 ft. of shaft through slates, most of which was done by raising. The total cost of this work, including 10x10-in. shaft sets, was $3015, or about $18.50 per ft. of shaft. The mill crushed 11.15 tons per stamp. Ore reserves were estimated to contain 403,100 tons averaging $9.50 in gold and 5.3 oz. of silver per ton. This property is on the northwest end of the Esperanza and the El Oro Mining & Railway Co.'s properties.

Osceola Consolidated

The annual report of the Osceola Consolidated Mining Co., Lake Superior copper district, Michigan, for the year ended Dec. 31, 1913, shows that the company produced 11,325,010 lb. of refined copper from 735,044 tons of rock stamped, at a net cost of 12.11c. after crediting miscellaneous receipts. This is a decrease of over 7,000,000 lb. in production, due to the general strike in the district. A summary of production made up from annual reports follows:

PRODUCTION

Year Ended Dec. 31	Tons of Ore Treated	Average Yield	Total Lb. Copper	Cost per Lb. Operating c.	Cost per Lb. Net (a) c.
1906	1,016,240	18.4	18,588,451	10.9	10.3
1907	811,603	16.4	14,134,753	12.4	11.9
1908	1,241,400	17.1	21,250,794	10.53	10.29
1909	1,494,845	16.9	25,296,659	9.47	9.08
1910	1,217,720	15.9	19,346,566	9.37	9.08
1911	1,246,596	14.8	18,388,193	9.28	9.17
1912	1,246,557	14.8	18,413,387	10.36	9.95
1913	735,044	15.4	11,325,010	12.30	12.11

(a) Cost after crediting miscellaneous earnings.

The company made a profit of $381,967, a decrease of $828,107, compared with the previous year. An eight-year summary of profits, dividends paid and balances of quick assets follows:

PROFITS, DIVIDENDS, AND ASSETS

Year Ended Dec. 31	Profit	Dividend	Balance of Quick Assets
1906	$1,623,188	$1,153,800	$1,337,164
1907	722,755	673,050	1,386,869
1908	677,105	576,900	1,487,074
1909	1,070,645	961,500	1,851,219
1910	758,585	769,200	1,840,605
1911	664,627	673,050	1,832,183
1912	1,210,074	1,153,800	1,888,458
1913	381,967	721,125	1,549,300

(Cents have been dropped)

These profits were accounted for as shown in the tabulation of receipts and expenditures as given herewith.

RECEIPTS

Year Ended Dec. 31	From Sale of Copper	Average Price of Copper, c.	Miscellaneous	Total Receipts
1906	$3,511,272	18.9	$135,538	$3,646,811
1907	2,409,933	17	71,372	2,481,306
1908	2,858,734	13.47	55,810	2,914,544
1909	3,368,913	13.32	96,942	3,465,856
1910	2,514,583	13	57,231	2,571,865
1911	2,351,275	12.79	20,097	2,371,373
1912	3,041,408	16.52	77,196	3,118,604
1913	1,753,626	15.48	21,184	1,774,810

(Cents have been dropped)

EXPENDITURES

Year Ended Dec. 31	Operating, Mine to Market	Construction, Etc.	Total Expenditures
1906	$1,868,140	$155,482	$2,023,622
1907	1,674,177	84,373	1,758,551
1908	2,091,823	145,615	2,237,438
1909	2,285,401	109,810	2,395,211
1910	1,746,340	66,939	1,813,279
1911	1,615,780	90,965	1,706,745
1912	1,734,198	174,331	1,908,530
1913	1,305,473	87,307	1,392,843

During 1913 there were 752,428 tons of rock hoisted from the mine, from which 17,384 tons, or 2.31%, were discarded. The average cost of mining, transportation, stamping and taxes per ton of rock treated was $1.60, compared with $1.23 per ton in 1912. During the first half of the year the cost was $1.11 per ton. Hoisting was resumed on Sept. 12, and at Feb. 21, 1914, there were 1117 men at work, as compared with 1143 in July when the strike was called. Total dividends to date amount to $11,987,375.

Daly-Judge

According to the 1913 report of the Daly-Judge Mining Co., Park City, Utah, receipts amounted to $617,393 and expenditures $469,522, leaving a balance of $147,871 of receipts over expenditures. Dividends amounting to $180,000 were paid, $32,128 of which came from surplus. The receipts were made up of $588,939 from ore sales and $28,454 from interest earned by surplus. The ore statement shows that 53,897 dry tons were mined of which 48,943 tons were concentrated and 4954 tons shipped. Costs for mining, milling and selling were as following:

		Per Ton
Mining	53,897 tons	$3.275
Concentrating	48,943 tons	0.765
General expenses	53,897 tons	0.497
Selling	20,582 tons	1.070
Total operating	53,897 tons	$4.848
Prospecting, explorations, deadwork		3.570
Engineering, drainage, construction, etc.		0.208
Total mining, milling and selling		$8.626

In addition to this cost, the cost of smelting, smelting losses, deductions and freights must be included to get the total cost of producing metals from this ore. Apparently the company credits itself only with the net payment from the smeltery as may be seen by the following calculation:

METAL CONTENTS OF SHIPMENTS FOR 1913

	New York Price Average	Total Value
611,378 oz. of silver	59.79c. per oz.	$365,542
619.04 oz. of gold	$20.67 per oz.	12,795
9,128,078 lb. of lead	4.37c. per lb.	398,897
7,678,589 lb. of zinc	5.468c. per lb.	424,195
407,242 lb. of copper	15.269c. per lb.	62,181
Total value of contents at Eastern market		$1,263,610
Amount actually received for metals from smelter		588,939
Approximate deduction for smelting, losses, freights, etc.		$674,671
Approximate deduction per ton of ore mined		$12.50

The total cost of producing metals from these ores, including delivery to Atlantic seaboard and all losses in treatment at the mill as well as by the smeltery, is something over $21 per ton of ore mined.

During the past year the top-slicing system has been adopted for mining the Daly vein. All drifts and raises are run in the foot wall and the method has given complete satisfaction. The mine is operated through an adit tunnel 6600 ft. long and a vertical shaft 1600 ft. deep. The tunnel cuts the shaft at the 1200-ft. station and serves as an outlet for all ore. Waste is hoisted to the collar of the shaft.

Rochester Mines Co.

The first annual report of the Rochester Mines Co., Lovelock, Nev., for year ended Dec. 31, 1913, shows gross receipts from royalties amounting to $25,836, in addition to these royalties due amount to $5426. The company also received $20,000 from the sale of 81,000 shares of Treasury stock. Statements show about $18,000 in cash, royalties due and bills receivable. A total of 14,726 tons were shipped from all leases, for which smelter returns amounted to $368,770. The smelter pays for 95% of the gross value of the ore, the returns averaged $25.04 per ton, which was distributed as follows: to leases, $9.79; for wagon hauling, $4.43; for royalties to company, $2.12; for railroad freights and treatment, $8.70 per ton shipped. Development work consisted of 8160 cu.ft. of cuts and trenches, 4233 ft. of drifts and crosscuts, 634 ft. of shafts, 730 ft. of raises and 165 ft. of winzes. Reference is made to a plan on foot to consolidate several of the Rochester properties.

These would be the Rochester Mines Co., Rochester Weaver Mining Co., and Nenzel Crown Point Mining Co., and also probably the Rochester Belmont Mining Co., Original Rochester Mines Co., and Pocohontas Mining Company.

Hedley Gold Mining Co.

The 1913 report of the Hedley Gold Mining Co., Hedley, B. C., shows a profit of $405,254 from the treatment of 70,796 tons of ore averaging $12.03 per ton, total value $825,261. The mill recovered $802,330 or 94%, 77% by concentration and 17% by cyanidation. Little development work was done as the power plant was taxed to its limit to keep the mill running. The Dickson shaft, 30° incline, 8x16 ft. in clear, has been sunk to a depth of 700 ft. From this point, drifting is expected to cut an orebody of $20 grade indicated by two drill holes in 1912. Recently a hole from the bottom of No. 5 incline showed an average of only $7 per ton for this ore. A large body of $8 to $9 ore to the northeast of No. 5 incline has been indicated by four drill holes. An 1800-hp. hydro-electric plant is planned to be situated on the Similkameen River at a cost of about $200,000. Ore reserves are now estimated to contain 413,000 tons of $10 ore. Dividends aggregating $360,000 were paid. All expenses except $13,028 spent on the new power plant are stated to have been charged to operations; these were equal to about $5.62 per ton milled. A reserve of 10,000 tons of broken ore has been maintained in the stopes.

National Lead

The National Lead Co., New York, earned $2,458,305 during 1913, according to its annual report. Dividends aggregating $2,325,394 were paid; $1,705,732 on preferred stock and $619,662 on common stock, leaving a balance of $132,911 to be added to surplus. In figuring this profit, it is stated liberal allowances were made for maintenance and repairs. Independent of these deductions, $488,469 was spent on new construction. The insurance fund has now reached, with earnings of the fund itself, $1,000,000, which is considered ample for the needs of the company. Owing to rearrangement of accounts, no comparison is made with 1912 statements. Current assets totaled $11,395,829 and accounts payable, $520,688. Of the current assets, $337,813 is cash in bank and $7,259,043 stock on hand. The company has been extending its work for the safety and health of its employees and pension system. Requirements of present laws have been met and where no laws have been enacted covering compensation for injuries and disability the company has voluntarily provided for same. Stockholders numbered 6752 on Dec. 31, 1913; of this number, 47% were women.

Construction of an All-Steel Dredge--III

By Lewis H. Eddy*

SYNOPSIS—Description of the driving machinery and electric power and lighting equipment of Yuba No. 14 all-steel bucket-elevator dredge at Hammonton, Calif.

Installation of driving machinery on Yuba No. 14 all-steel 16-cu.ft. dredge, at Hammonton, Calif., was begun immediately after the hull went afloat and continued simultaneously with the installation of other operating machinery and electrical equipment until the completion of the dredge on Dec. 16, 1913. The principal part of the electrical equipment was installed in November and December. The electric motors are General Electric 3-phase 60-cycle induction type, 440 volts. The driving motors are variable speed, the pump and tool motors are constant speed.

Main-Drive Gear, Motor and Ladder Hoist

The upper tumbler shaft is driven at both ends through a double train of openhearth cast-steel gears. The intermediate shafts are of nickel steel, 10-in. diameter in the gear, 7½-in. diameter in the bearing. These are larger than Yuba No. 13 shafts. The pulley shafts are of differential type, dividing the load equally between the two trains of gears. The main-drive bearings are steel castings babbitted, except the bases for intermediate and pulley shafts, which are of cast iron.

The upper tumbler shaft is connected to the motor by a 32-in. 3-ply rubber belt. The motor is 400 hp., 514 r.p.m., situated forward of the ladder-hoist winch on the main deck.

The ladder-hoist winch is similar to Yuba No. 13, except that the drum gear is bolted to the drum housing instead of being keyed to the shaft. Housing at each end covers brakes operated from the intermediate shaft. The main drum is double type without grooves. The winch base is of structural steel. The winch is equipped with two plow-steel wire ropes, each 1½ in. diameter, 1200 ft. long. The belt is triple leather, 32 in. wide.

Revolving-Screen Drive and Motor

The revolving-screen drive is of friction-roller type, provided with clutch for operating. All thrust rollers are carbon-steel castings except the drive rollers, which are of manganese steel. The bearings are cast-iron babbitted, except the main-drive roller and intermediate shaft bearings, which are cast steel. The drive-roller shaft is of nickel steel; all other castings are forged carbon steel.

The screen-drive motor is 75 hp., 600 r.p.m., situated in the screen house on the main roof of the deck housing.

The 42-in. conveyor belt is driven from the upper drum of the stacking ladder. The drum is connected by chain belt to a 60-hp. motor, 720 r.p.m., situated on the outer end of the stacking ladder. The stacker-hoist winch is a cast-steel drum driven through a set of steel-worm gearing. The worm-wheel rim is of bronze, mounted on a cast-iron spider. The whole is mounted on a rigid cast-iron sub-base separately fitted with carbon-steel shafts. The winch is equipped with a crucible-steel rope, 1 in. diameter, 750 ft. long.

The swinging winch is composed of eight drums, each 24-in. diameter. The drums, gears and friction drives are all of cast steel, the whole mounted on heavy structural-steel base. The speed change is regulated by gears and clutches. The gears on the spud hoist and spare drum shaft are provided with jaw clutches, so that the shafts do not turn except when the operating drums are connected to them.

The bow swing is equipped with two plow-steel wire ropes, each 1⅛ in. diameter, 750 ft. long; the stern swing with two crucible-steel wire ropes, each 1 in. diameter, 550 ft. long. The spud hoist is equipped with two plow-steel wire ropes, each 1 in. diameter, 550 ft. long.

The swinging-winch motor is 35 hp., 600 r.p.m., situated on the main deck forward of the winch.

10,222 Ft. of Steel-Wire Rope

In addition to the 6850 ft. of wire rope mentioned in connection with the driving machinery and the 1360 ft. of tail sluice and footbridge rope detailed in the description of operating machinery, there is used in connection with other operating and driving parts, not mentioned in either description, 832 ft. of bridge cable and 1180 ft. of wire rope, making an aggregate of 10,222 ft. of steel-cable and steel-wire rope.

The four pumps are direct-connected to the motors. The high-pressure pump motor is 150 hp., 600 r.p.m. The low-pressure pump motor is 75 hp., 600 r.p.m. The 6-in. pump motor is 50 hp., 1200 r.p.m. The 6-in. vertical pump motor is 10 hp., 900 r.p.m. The tool motor is 2 hp., 1800 r.p.m. with pulley and sliding base, situated on main deck forward. The pump motors are all situated on the main deck.

There are three 200-kw. oil-cooled transformers with a primary voltage of 4000 and secondary of 230 and 460 volts, complete, with oil, for the driving machinery. There is one 15-kw. oil-cooled transformer with a primary voltage of 4000 and secondary of 115 and 230 volts, with oil, hooks and cutouts, for the lighting system. There are four inverse time-limit overload panels, one each for the four pumps.

All switchboards are made of black slate, mounted on pipe supports. A remote-control oil switch for controlling the main incoming lines is situated on the upper deck, supported by pipe framework. The switchboard composed of panel for incoming line and two-circuit feeder panel for controlling the digging and winch motors is situated in the winch room. The instruments mounted on the incoming panel of this switchboard are: One 5-amp. a.c. ammeter with 150-amp. scale; one 175-volt a.c. voltmeter; one 110-volt 5-amp. polyphase, indicating wattmeter with 1200-kw. scale. The feeder panel is equipped as follows: one 60-amp. a.c. primary ammeter, for winch motor; one 5-amp. a.e. ammeter with 800-amp. scale, for main-drive motor; one 600-volt 200-amp. automatic oil switch, for winch motor; one 600-

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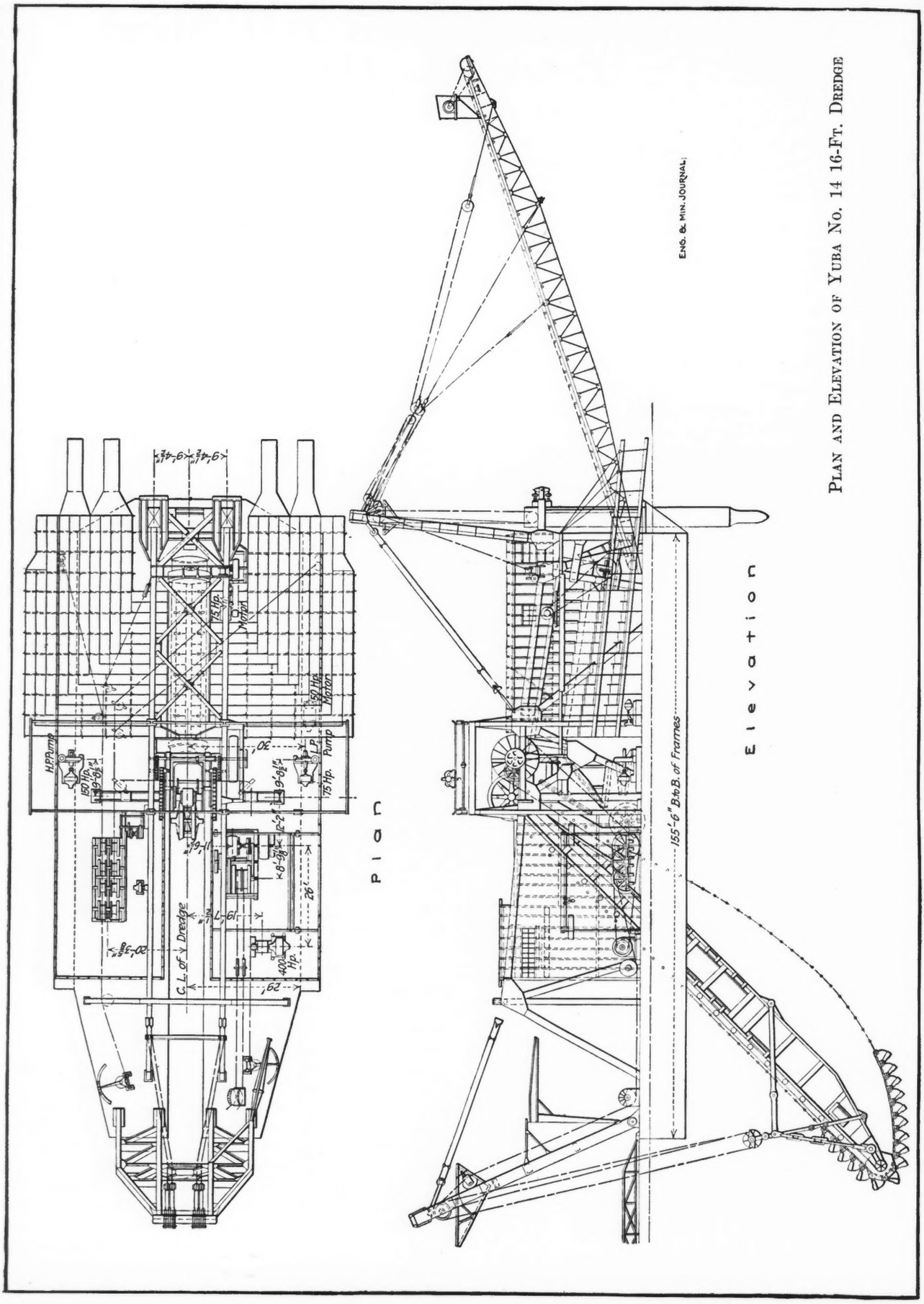

PLAN AND ELEVATION OF YUBA NO. 14 16-FT. DREDGE

volt 800-amp. automatic oil switch, for main-drive motor.

A separate switchboard composed of two panels for controlling the stacker and screen motors, by means of automatic oil switches, is situated near the stern, on the gallery. A switchboard composed of two panels for controlling the pump motors is situated on the lower deck. Panel boards and cabinets are provided for controlling the lighting circuits, and are situated at convenient points on the dredge.

Electric-Lighting System

The lighting of the dredge is taken from the 15-kw. transformer, with a primary voltage of 4000 and secondary voltage of 115 and 230 volts. The primary current for this transformer is tapped in ahead of the main oil switch, so that with the main oil switch in the open or closed position the lighting system is not disconnected from service.

The 115- and 230-volt secondaries from the transformer feed three General Electric eight-switch panel boards, one each in pilot house, main deck, stern deck near stacker and screen controllers. The pilot-house board controls the bow gantry, winch room and the lights over the upper tumbler and gears. The main-deck panel controls lights on main deck and gold-saving tables. The stern panel controls the lights in hull, stern gantry, stacker and screen drive.

There are 300 fifty-watt lamps and two arc lamps distributed from these boards. All wiring is in conduit, 640 watts to a single circuit. There is 3500 ft. of conduit, from 1 in. to ½ in.

The electric wiring, embracing the operating and lighting of the dredge and including wiring aboard and ashore, required 3600 ft. of primary and secondary cable, 1500 ft. of rheostat cable, 7700 ft. of rheostat wire and cord; a total of 12,800 ft.

The leads to motors are installed in conduit. The shore cable is No. 1/0 B. & S. 3-conductor, 750 ft. long, covered by heavy waterproof braid and protected by No. 10 B.g.w. galvanized-steel wire armor. The motor and transformer secondary is single-conductor cable, 1750 ft. long; working pressure 600 volts. All other cables similarly have a working pressure of 600 volts. The rheostat cables are asbestos covered.

All necessary hand levers, quadrants, reach rods, bell cranks, shafts and bearings are provided for connecting all clutches and brakes of the swinging winch and ladder-hoist winch, also for connecting the main-drive machinery with the operating or winch room; so that the principal operations of the dredge are easily controlled by one man.

Corporation's Remedy Against Directors

By A. L. H. Street*

Although the directors of a mining corporation are not responsible for errors of judgment made in good faith in managing the company's affairs, the Massachusetts Supreme Judicial Court, in the recent case of United Zinc Cos. vs. Harwood, 103 Northwestern Reporter 1037, holds that they may be held liable for secret profits made by them in an arrangement with outsiders whereby stock of the company was issued in exchange for mining lands worth less than the stock. The court holds that the company is not limited to the mere remedy of rescinding the contract, and that right to rescind is not lost through the mere fact that the land has been mined and its value somewhat diminished thereby, a court being empowered to impose equitable conditions upon the company's right to rescind. But it is declared that the right of the corporation to maintain a suit on account of any fraud practiced upon it by its directors did not pass to another company to which it assigned its assets.

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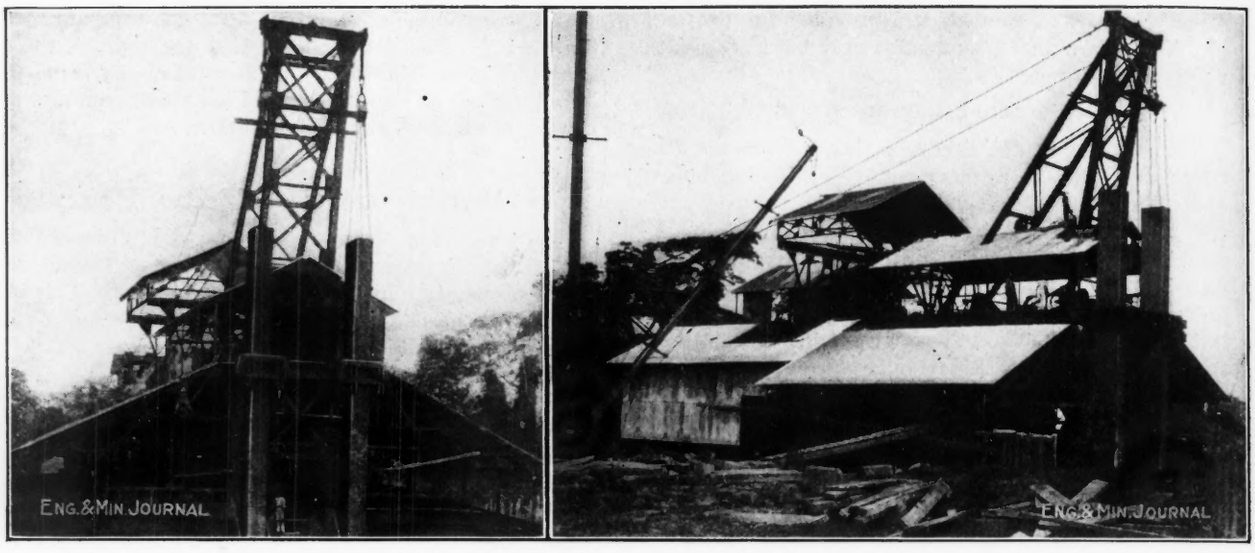
History of the Pato Placer

On account of the extraordinary yield from the Pato gold-dredging operations in Colombia last year, some facts of its early history may be of interest. This property was originally denounced in 1860 by Señor Vasques and worked till his death, when the property was left to José Granados, who built ditches and employed a number of natives to work the California Hill section of the property. A small water supply was secured and the California Hill gravel hand sluiced by these natives, who worked as tributers, selling their products to Granados and buying from him all their supplies; this doubling up of the old "company-store" idea left the natives but little for their work. On Granados' death, in August, 1902, two-thirds of this property was deeded to Señora Granados; from this marriage there was no issue, and Granados left the other third of the property to two illegitimate children.

After a lapse of a few years, an option on the property was taken by H. S. Derby, who succeeded in interesting Chicago men in this ground. The Chicago company sent Alexander P. Rogers to Colombia to prospect the property. As his time was limited, Mr. Rogers, after some preliminary drilling, decided to concentrate his attention on a square of about 90 acres. This work revealed a gravel favorable for dredging and a rich gold content, averaging about 45c. per cu.yd. The Chicago company did not equip the property at this time, but in 1908 sent C. H. Munro down to Colombia to continue the drilling. Mr. Munro proved up 220 acres in addition to the square first prospected by Mr. Rogers; averaging the results of both drilling campaigns, he reported an average of 31.3c. for the entire 310 acres.

About one year later, the Oroville Dredging interests sent their engineers to check this drilling, and finally decided to take the property. In order to equip the property, the company was compelled to borrow a large sum of money. This loan, with extraordinary expenses incident to preliminary operations, brought Oroville's investment in Pato up to about $1,200,000. In dredging in the richer tested area, the yield from the Pato dredge for the five months ended Jan. 1, 1914, was over $354,000, or nearly 75c. per cu.yd., besides which $67,538 were obtained in dredging a channel to the tested area. Prospecting on the Pato property, which now includes about 40,000 acres, has indicated additional gold-bearing areas, and the Oroville company has further strengthened its position by the purchase of the San Francisco property on the opposite side of the Nechi River, where in 90 acres a gold content of $4,800,000, or about 70c. per cu.yd., has been indicated by drilling.

Pato Dredging Operations

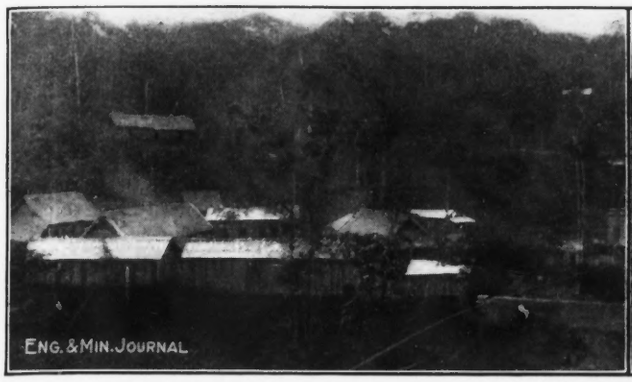


PATO DREDGE UNDER CONSTRUCTION, NECHI RIVER FIELD, NEAR ZARAGOZA, ANTIOQUIA, COLOMBIA

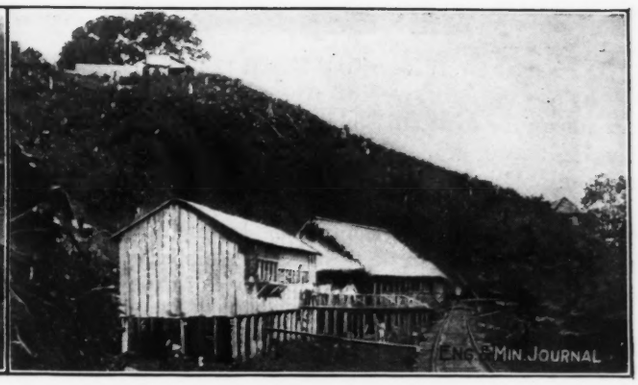
Stern views showing dredge before stacker was placed. The canopy over the hopper and the main gantry, also all of the truss work and roofing of the screen-room housing have since been removed, lightening the boat by eight tons high above the water line. Operations are controlled by Oroville Dredging Co. interests.

SAWMILL ON NECHI RIVER AND WAREHOUSE IN THE DISTANCE ON RIVER BANK

A typical Colombian river. The dredging ground on the Pato, Jobo and Camboro alluvial claims is practically dry ground.



WHERE LABORERS FORMERLY LIVED

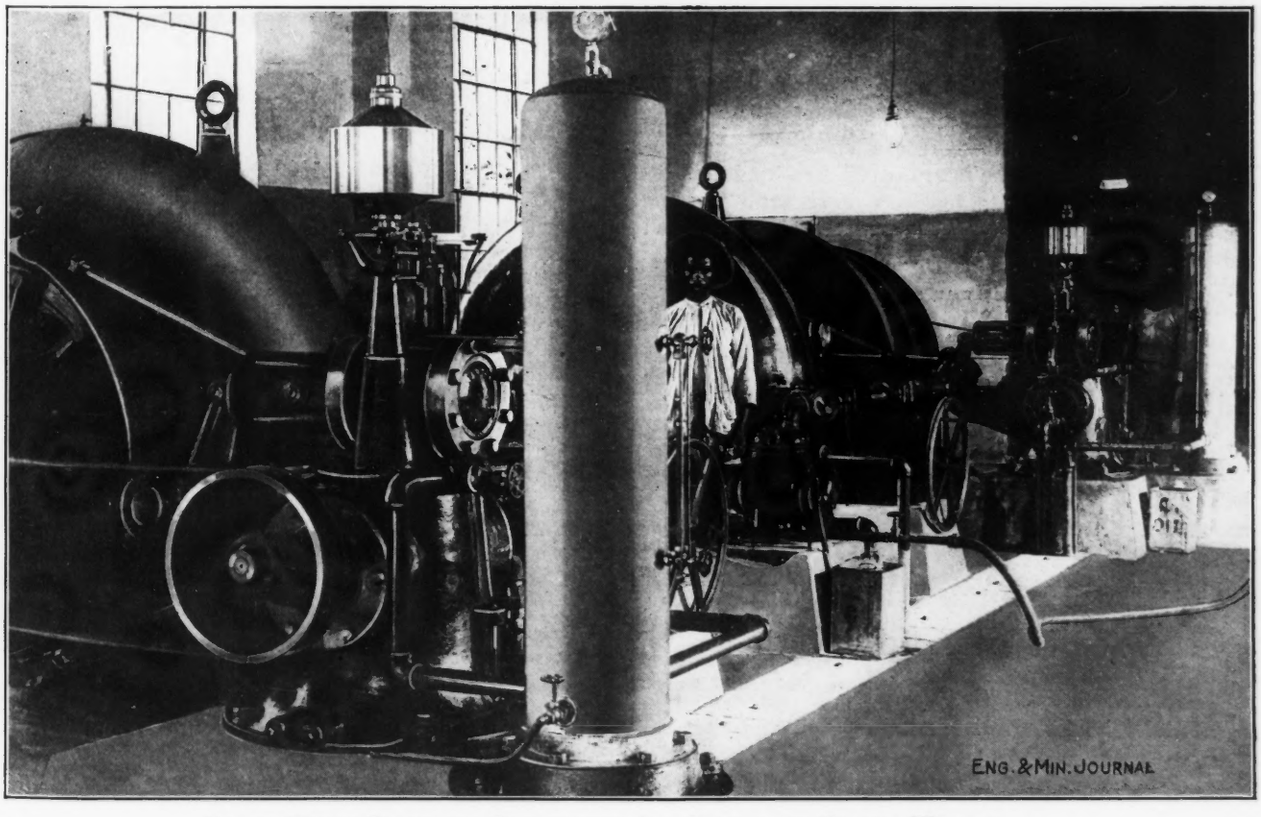


YUBA CONSTRUCTION CO.'S BOARDING HOUSES

These structures have since been torn down. Railroad in view at right led from warehouse to dam; it has since been torn up.

POWER HOUSE AND DAM ON SAN JUAN CREEK ON DAY POWER WAS FIRST GENERATED

Surplus water flows over dam; view at right taken just before overflow began.



POWER-HOUSE INTERIOR; GENERATORS ARE DRIVEN BY PELTON WHEELS

The negro in the picture is representative of the most skilled native laborers employed in building the company's plant.

Miami Copper Co.

The report for 1913, of the Miami Copper Co., operating at Miami, Ariz., records a production of refined copper amounting to 32,867,666 lb. based on treatment of 1,058,784 tons of ore. The mill extraction was 71.06%, as compared with 69.39% in 1912. Experiments continued during 1913 in Section 6 of mill indicate that by close of 1914 even this extraction will be bettered by mechanical changes in the mill. Northwest orebody has been set aside for last two years for purpose of experimenting on best size of shrinkage stope and pillar to be used in extraction of ore, and results obtained here have been of great value in laying out Captain orebody with much smaller rooms and pillars than those used in experimental section of mine. In April, a caving of capping *en masse* above this experimental section occurred which threw back production, but without causing any material damage to mine other than loss of product and increased mining expenses in that section for a few months. Improvements have been made in shaft crusher-house so as to make a product of approximately ½-in. maximum size, and this in addition to improved grinding and concentrating facilities in mill has increased its capacity to 3300 tons per day. Certain changes, in way of regrinding middlings, and additional concentrating machinery, will bring capacity up to 4000 tons of ore per day in latter part of 1914, and by that time mine will be able to furnish this tonnage. New development in sulphide ore has not quite kept pace with extraction. Jan. 1, 1914, there was available 20,300,000 tons of sulphide ore, average of all samples showing a grade of 2.45% copper. No attempt has been made to increase the 17,200,000 tons of low-grade material averaging 1.21% copper reported last year. Recent revival of interest in hydro-metallurgy of copper has caused the company to develop partially its resources of mixed oxide and sulphide ore, with result that on Jan. 1, 1914, there was developed approximately 6,000,000 tons of this material averaging 2% copper. It seems likely that a mixed water concentration and leaching process will make this ore available. The installation of spring rolls for intermediate crushing and of Hardinge pebble mills to replace chilean mills for fine crushing were completed during 1913. The anticipated reduction in cost due to the various mill improvements was obtained, cost of treatment from mine rock to concentrate being as follows:

Direct crushing expense	$0.20806
Direct concentrating expense	0.18852
Tallings and concentrates, handling	0.05880
Water for concentrating	0.08553
Betterments	0.03134
Total	$0.57225

The results of milling operations for the year are as follows:

Ore milled	1,058,784 tons at 2.30% copper
Concentrate produced	45,410 tons at 38.09% copper
Copper in concentrates	34,597,568 lb.
Copper per ton ore	32.68 lb.
Mill extraction	71.06%

Based on smelter returns, cost of refined copper in concentrate on board cars at Miami was as follows:

	Per Ton Ore	Per Lb. Copper
Mining	$1.6030	$0.05164
Milling	0.5722	0.01843
General	0.2899	0.00900
Total	$2.4651	$0.07907

Bonded indebtedness was reduced from $58,000 to $25,000 by conversion of bonds, and capital surplus increased from $1,967,882 to $1,991,176. The entire expense of the cave-in which occurred in April has been charged to operations of 1913 and largely accounts for increase in cost of production over previous year. Cost of producing and marketing copper for 1913 was 10.6086c. per lb. compared with 9.5884c. in 1912. During year cost of renewal and repairs was charged to operating expenses. In addition, there was a direct charge for depreciation of plant amounting to $223,874, making a total charge for depreciation to date of $392,970. As in the previous year, cost of current development of mine was added to capital, while development account was credited with sum of $327,138, equal to 31c. per ton of ore hoisted. This covers amount of depreciation of mine plant and proportionate cost of past and future development based on proved tonnage in mine. In 1913, four quarterly dividends, each of 50c. per share, were paid. There was a decided increase in the taxes paid by the company, presumably the result of the new taxing system in Arizona; at any rate the company paid about $123,000 in 1913, but only $56,000 in 1912. It is also noteworthy that the ore treated in 1913 averaged only 2.3% copper, as against about 2.4% during the previous year.

Notwithstanding the extraordinary expenses due to the April cave and the subsequent restricted operations of several months, the operating profit for 1913 was $1,529,271 or slightly more than the normal dividend requirement; however, the company adhered steadfastly to its policy of charging depreciation, and reduced its outstanding bonds to $25,000, thus reducing the profit balance to $1,305,397. Charging all the extraordinary expenses to the current operating account brought the cost of Miami's 1913 copper up to 10.6c., but it leaves the company in an excellent position as regards the coming year. By reason of the more favorable smelting contract made with the Inspiration Consolidated Copper Co., the smelting charge was much lower; the full effect of this contract was not shown in the 1913 figures, but the smelting and refining costs were about ⅓c. per lb. less than during the previous year. Normal production conditions have now been restored, as is indicated by the February copper cost which is reported as less than 9c. per pound.

Electric Iron-Ore Smelting at Trollhattan in 1913

The result of smelting operations from Jan. 1 to Dec. 31, 1913, is given in the *Jernkontoret's* report (Sweden) as follows:

Lump ore used, kg.	9,381,980
Slig (19 per cent. of ore), kg.	2,182,575
Total ore, kg.	11,564,555
Limestone (unburned) (8.6 per cent. of ore), kg.	1,001,155
Total charge, kg.	12,565,710
Charcoal, hl.	175,623.5
Pig iron produced, kg.	7,333,995
Pig iron produced in per cent. of ore	63.42
Pig iron produced in per cent. of charge	58.37
Charcoal used per ton of pig iron, hl.	23.95
Time required for operating, hr.	7970.6
Time required in stoppages, hr.	789.4
Average load, kw.	1.808
Kw.-hr. for works (including motors and light)	15,838,250
Kw.-hr. for works per ton of pig iron	2.160
Kw.-hr. for smelting plant per ton of pig iron	2.116
Pig iron result per hp. (power as for the whole of the works) tons.	2.98
Pig iron result per hp. (power as for smeltering plants) tons.	3.05
Electrode consumption per ton of pig iron, gross, kg.	4.64
Electrode consumption per ton of pig iron, net, kg.	4.14

Coal Production of South Africa in 1913 was: Transvaal, 5,225,036 tons; Natal, 2,898,726; Orange Free State, 609,973; Cape Colony, 67,481; total, 8,801,216 tons, an increase of 684,138 tons over the previous year.

Correspondence and Discussion

Molybdenum in Cyanide Solutions

I was greatly interested in J. E. Clennell's article on "Molybdenum in Cyanide Solutions," as his experience was similar to mine while investigating some of the peculiar reactions observed in the analysis of slags obtained in melting cyanide precipitates. This investigation resulted not only in the identification of molybdenum, but also selenium and to a lesser extent tellurium.

It had been frequently observed that the washes, after acid-treating the precipitate, were brown in color, and it has also been demonstrated that this color is due to a reduction product of molybdenum, formed during the acid treatment. Research revealed the presence of molybdenum in the general solutions to a surprising extent, and lastly, it has been detected in the dark froth that collects over cones, launders and settlers.

The most satisfactory test for molybdenum is the sulphocyanide reaction which is delicate enough to be applied directly to the solution. The test is conducted as follows: Take about 50 c.c. of cyanide solution, add a drop of ammonia (most cyanide solutions contain sufficient ammonia and generally this addition is unnecessary), add a crystal of potassium sulphocyanide, then render acid with sulphuric, and add a strip of zinc. In the course of a minute, a beautiful carmine-red coloration is produced, which gradually changes to brown, and eventually a dirty green. This red coloration is different from the ferric sulphocyanide color, and moreover is produced under reducing conditions where the ferric-sulphocyanide coloration cannot exist.

Satisfactory quantitative estimations have been obtained by colorimetric analysis in comparing the thoroughly reduced cyanide solution with a correspondingly reduced solution of molybdic acid. The general color of such solutions is dirty green by reflected light, and brown by transmitted light.

I appreciate Mr. Clennell's difficulties with identifications, as the cyanide chemist must ever bear in mind that he is dealing with solutions that bristle with organic derivatives; many of the metals, notably copper and mercury, have lost their ionic identity in combinations with such derivatives and hence our common inorganic tests do not apply. Or if the metals do respond to some tests, they fail in others, and one is led into great confusion. This undoubtedly explains why, in general, relatively small amounts of copper and mercury are precipitated in comparison with the amounts in solution. The Liberty Bell solutions carry even a greater amount of copper and mercury than precious metals, yet after passing through the zinc boxes where precipitation is so perfect that the tails contain only 1 oz. per ton in gold and silver, the copper, as well as the mercury, is but slightly diminished.

Mr. Clennell's investigation regarding the effect of molybdic acid upon cyanide is indeed timely. It is time that we were molding into form some terse and definite ideas regarding acidity, humus acids, organic matter, reducing agents, cyanicides, foulness, etc., which for vagueness of meaning constitute a most remarkable collection of indefinite terms.

A. J. WEINIG.

Telluride, Colo., Feb. 23, 1914.

Tube Mills

A short but interesting account of changing a tube into a cone mill is contained in the JOURNAL of Nov. 22, 1913. How wonderfully one's viewpoint influences judgment! As a granulating device in a concentrator, the result attending the alteration of the tube into a conical mill was doubtless justified. Might not an equally gratifying result have attended the shortening of the tube?

From the viewpoint of one interested in all sliming, where a mechanical device is directly valued as its efficiency of fine reduction, this brief account appears distinctly laudatory of the comminuting or sliming properties of the cylindrical tube.

There are interesting features in this particular tube and its performance. It is the first time in my apprenticeship of tube milling that I have encountered a tube of such sensible proportions, viz., 7x12 ft. The more's the pity it found itself unappreciated, or rather unsuited for this particular requirement. The drive at the discharge end is commendable.

The record shows practically no saving of power relative to output. Before the change, the tons crushed per horsepower equaled 1.30; after the change, the tons crushed per horsepower equaled 1.35. Regarding its sliming qualities, the —100-mesh product before the change was 83.5%, and the —100-mesh product after the change was 74.4%. This result is to the credit of the tube, which is a fine-crushing device. The trouble appears to have been that a machine designed for one object, sliming, was required to be equally efficient in a totally different function, granulating.

With regard to the moisture of 58.9% and 57.7%; for sliming purposes moisture varies from 28% to 38%, the drier charge consuming more power. As a sliming device it is interesting to note that a tube 7x12 ft., running at 22¼ r.p.m., with moisture 58.9%, crushes 98.6 tons per day of coarse feed to 83.5% of —100-mesh, consuming 75.6 hp. This appears an excellent performance.

I am operating a tube 5x22 ft., running at 30 r.p.m., with ribbed liners. It is sliming at the rate of 100 tons of — 100-mesh material per 24 hr., working up a coarse product from a stamp mill with 3-mesh screens. The stamp-mill discharge is:

+ 3	18	+ 80	13
+ 20	39	+ 100	3
+ 40	14	— 100	13

The ore is a hard, dense, dark quartz with schist, used with good effect for tube-mill rock in place of flints. The tube-mill feed consists of the discharge from mill and

the return sand pump, which contains 68.5% +100 and 31.5¼ —100-mesh. The discharge from the tube mill contains 96% —100-mesh. The moisture is maintained from 32 to 38%, and the tube is run with the charge well below the center. The power consumed is from 80 to 90 hp. The power is dependent on moisture and on the pebble load.

The 7x12-ft. tube mill crushes an equal amount for less power. The —100-mesh product, taking into account the slime introduced from imperfect classification, is fully equal. The inference is that a tube 7x12 ft. is better proportioned for economical and efficient results than a 5x22-ft. That is to say, by increasing the diameter and diminishing the length, we increase the economical efficiency.

Tubes 6x16½ ft. are in use in South Africa and are being introduced into India. The weak point of the tube is its nondelivery of the finely pulverized product as soon as produced. Length accentuates this evil. Solution of the trouble is found in short mills.

Two essentials of a tube are a diameter proportionate to the size of feed particles and a length only sufficient to insure economic and efficient grinding. My proposal is a tube 8x8 ft., fitted with 3-in. ribbed, manganese-steel lining, taking the product of a 2- or 3-mesh screen, preferably arranged in series, and followed by a tube, say 6x8 ft., or dimensions suited to its feed. Trunnion discharge should have Neal open outlet for pebble feed. A discharge-end direct motor drive with flexible coupling and scoop feed for thick pulp at feed end should be included. The only objection to this drive is the possible difficulty of excessive starting torque in the motor.

The conical mill already is constructed with 8 ft. diameter; that is, the part that does the crushing. Why not construct a cylindrical tube of like diameter?

H. E. WEST.

Nundydroog Mine, Oorgaum, India, Dec. 28, 1913.

Electric Shovels

The article on electric shovels, in the JOURNAL of Feb. 21, and the remarks thereon, seem worthy of a few comments.

Mr. Rogers' comparison of costs other than power for operation is conservative and rather favors the steam shovel. The watchman is necessary for the steam shovel, as he keeps the fires going when the shovel is not working, and would not be needed on the electric shovel.

It is not long since the electric hoist was a plaything, and many doubted if it could ever be made efficient. Yet we now see many installations where the steam hoist formerly held sway, and its use has made possible the operation of many inaccessible properties that would be otherwise idle today. The same may be said of electric pumping. The electric pump has come to stay, and it is gradually increasing its field of usefulness. Since the work of these two machines has proved satisfactory, we are not wrong in expecting much from the electric shovel.

The steam shovel has been developed to a high degree. It does its work, but it is not an efficient machine. The engines are quick and flexible, but they are wasteful of power. The machine is a mankiller; the constant vibration of the heavy reciprocating parts and the noise of the exhaust make it hard on the operator. The smoke is a nuisance. The taking of coal and water consumes time, and is an added expense however accomplished, a charge properly to be made against the steam shovel; the time consumed means so much less digging time. The boiler and steam pipes are a constant danger; many serious and fatal accidents have been the result of their use. Winter operation discloses many disadvantages in steam shovels; not so many in electric shovels. It is my impression that the electric shovel should be able to dispense also with one or more pitmen. Many operators do what is fashionable in their own districts, so that a new machine makes slow progress in proving its merits. The fact is granted that the steam shovel does the work and has worked wonders in the economic history of the nation, but the last word has not been said, and I do not believe the ultimate digging machine will be the steam shovel.

The electric-shovel manufacturers are on the right track, and if they keep up the rate of progress made to date, they will eventually have a machine doing all that the steam shovel does, but doing it better, more cheaply and more safely. I expect soon to see the electric-shovel runner emulate the steam-shovel runner, who claimed he could pick a man's pocket with his machine.

FRANK A. BOWMAN.

Gilbert, Minn., Mar. 13, 1914.

[We also expect the electric shovel to come. The line along which Mr. Armstrong, of the Penn company, is working, using hydraulic control and transmission is most promising. The electric hoist and pump have arrived, but the electric drill has not. The work of a shovel is much like that of a drill.—EDITOR.]

Theory vs. Practice

We have all heard much about the great difference between theory and practice. To show how great this difference may be, I cite the following instance.

A centrifugal dredge pump was being tested to ascertain the tonnage of coal and water it would handle, and its action on the coal it was to pump. The engineer had some data at hand to start with. The makers stated that it would handle 25% solids in the stream of water, but this is all he knew about it. He set about to get the tonnage by measuring the flow of pulp, and calculating it from that data. The report, in brief, was:

CENTRIFUGAL-PUMP DATA

R.p.m. of impeller	1283
Greatest circumference of impeller	4.71 ft.
Average circumference of impeller	2.35 ft.
Average speed of stream	3015 ft. per min.
Diameter of discharge	6 in.
Cubic feet per minute, delivery	2366.7
Assuming 25% coal in the stream, equal to 591.6 cu.ft. per min., the hourly delivery would be	887.4 tons

Imagine a 6-in. pump throwing a stream of coal and water at that rate. Of course, when the pump was put into service, a big discrepancy was found, for it would only handle about 49 tons per hour. It was then discovered that about 1000 gal. per minute was a fair working rate for the pump under these conditions, instead of 17,700 gal., arrived at by the "dope" from the test.

It is such instances as this that make people shake their heads and say, "It might be so in theory, but not in practice." Such as this is not theory, but simply "boneheadedness." Theory and practice are closely related in most lines, if the theory is correct.

Springfield, Ill., Mar. 12, 1914 C. C. CONOVER.

Editorials

The Metal Markets

While the metal markets have nearly all been weak during the last quarter, there have been interesting differences among them. Copper has behaved the most satisfactorily of all. Whenever it has fallen to the neighborhood of 14c. there has been large buying and the price has promptly rallied, not much to be sure, but nevertheless it has exhibited a noteworthy resiliency. This has occurred at times when iron and steel have been falling and has negatived the idea that these metals always move together. In the long run their course is no doubt quite similar, but that is true not only of these two metals, but also of most of the metals.

That copper and iron do not necessarily move together at all times is easily to be understood. They are not used in the same proportion for all purposes. A steam railway uses a great deal of iron and relatively little copper; a telephone company uses a great deal of copper and relatively little iron. That the ratio of pig-iron consumption to copper consumption should continue fairly constant is simply the result of striking a general average. Probably there is a similar constancy between copper consumption and spelter consumption.

Furthermore there is a difference in the nature of the markets. The American iron and steel market is essentially a domestic one. The American copper market is international. Europe takes fully one-half of our copper; during the last six months it has taken much more than one-half. This has accounted for the upward turns in the copper market, while steel has been falling. American industry has been checked and the steel industry has suffered directly in proportion, but copper consumption in Europe has continued large and that has been a bulwark to our copper market.

The American spelter market is even more a domestic market than the iron and steel. We rarely export spelter or manufactures thereof. Consequently this market reflects domestic conditions alone. It is subject moreover to things peculiar to itself. Of all the great metal industries, this is the one that has least been consolidated. Herein may the advocates of perfect competition, of *laisser faire*, see it in untrammeled development. The zinc producer has not for a long time been able to make any money. Theoretically the least favorably situated concerns ought to suspend operations, but then they lose money. If they operate at materially reduced capacity they lose money. The other alternative is to run full, or nearly so, pile up stocks and trust to luck. With the zinc smelters in their present situation it is a question of how to lose the least money. The only thing in their favor is the relative cheapness at present of carrying their unsold stocks of spelter. With things thus, there is no wonder that the price for spelter rules low.

Lead also is a metal of domestic market and conditions peculiar unto itself. Lately we have indeed exported five or six thousand tons, thanks to a relatively high price in Europe, which has been deprived of its Mexican supply, but that is an extraordinary development. Incidentally it has been shown that we have not yet witnessed such a decline in price as would materially check our production.

Examining the plottings of the world's production of the metals lead lags behind iron, copper and spelter. Judging from this there was an idea several years ago that lead was working into a strong position, but recent history has not borne this out. Perhaps while lead production has lagged, lead consumption has lagged too. Lead is less immune from the competition of other substances than are iron, copper, zinc and tin. Those metals are in the main used for purposes for which they only will suffice. Not so in the case of lead. Two of its great channels of consumption are for sheet metal and for pigment. Sheet zinc may be used for some purposes instead of sheet lead; and zinc oxide and barytes may be used instead of white lead. Indeed, there has been a good deal of legislation prohibiting the use of white lead. The status of lead consumption as affected by these and other factors would be an interesting and valuable subject of statistical investigation.

The Cost of Producing Copper

In his last report to the stockholders of Phelps, Dodge & Co., Doctor Douglas dwells in a broad way upon the price to be expected for copper and the cost of producing the metal. The average price received for the copper produced by Phelps, Dodge & Co., during the 10 years, 1904-13, was 14.56c. per lb., net cash, New York. The range of prices during this period has been considerable, annual quotational averages in the neighborhood of 20c. being realized in 1906 and 1907, but the minimum of the period was 12⅜c. in 1911. This is quite a different showing from that of the previous decade, when upon occasions the price for copper fell under 11c. Doctor Douglas sees a greater stability of price during the last decade and infers that the price of copper in the future will not be lower. On the contrary, he anticipates that it will average higher in order to compensate for the increase in the cost of producing the metal. He says:

> Under legislative enactment and social aspirations the demands of labor will be more exacting, and the taxes, representing the cost of government (municipal, state and Federal), will become more onerous. The mines, being always under corporate management, will have to bear more than their fair share of the burden. The state taxes paid by this company and its subsidiaries have risen from $431,559 in 1912, to $605,431 in 1913, and Federal taxes, amounting to $178,872, based on 1913 business, have been levied. The cost of concentrating and smelting can probably be lowered by improvements in both methods and practice, but, with greater depth and the general decline in the grade of ore, the cost of mining will tend upward rather than downward.

There is another charge that is falling upon the copper-mining companies, like all other mining companies, which Doctor Douglas does not mention, viz., the expense that results from the workman's compensation

laws. Of course, this is not wholly a new thing, inasmuch as employers have always been liable for damages under the common law, but probably they never paid all that they should and caused a burden to fall upon the state. Now, the states not only increase their taxation for other purposes, but throw this burden directly upon the employers, which is correct in theory, but undoubtedly leads to some improper charges upon which the companies must reckon. Thus, S. W. French, general manager of the Copper Queen company, in his last report says: "Our experience confirms that of others, that there are an undue number of claims for minor injuries. The total payments on account of accidents, in 1913, were 1.17% of the amount of payrolls." In some cases, the insurance companies have required of mining companies a premium amounting to 6% of the amount of payrolls.

The measure to be taken by the companies in self-defense is, of course, the inauguration of systems which will reduce the number of accidents. It is cheaper to prevent accidents than to pay for them. This is one of the basic reasons for the "Safety First" movement, which is spreading like wildfire among industrial companies of the United States. Phelps, Dodge & Co. is going even further, being about to put into effect a plan whereby every new employee must first pass a satisfactory physical examination before being engaged. The purpose of this is to reduce accidents and increase efficiency.

Economically, the killing and maiming of men is a cost. Heretofore, the community has stood it. Now the community puts it upon the industry responsible. It must be reckoned in the cost of production. The state does not on this account rebate anything from taxation, but increases it.

The Lackawanna Decision

The United States Circuit Court, at Philadelphia, has decided against the government in its suit against the Delaware, Lackawanna & Western R.R. Co., which is the first of the proceedings brought with the avowed purpose of breaking up the anthracite combination to reach a decision. It will be remembered that the Lackawanna, which, under its Pennsylvania charter, is a coal-mining as well as a railroad company, sought to avoid the commodities clause of the Interstate Commerce law by the organization of the Lackawanna Coal Sales Co., to which all the coal mined was sold at the mines, the new company doing all the marketing and paying for the transportation. The stock was not held by the railroad, but was sold to others, preference being given to the stockholders of the railroad as purchasers.

The government claimed in its suit that the sales company was merely a cover and that its operations were really controlled by the railroad, notwithstanding its nominal independence. It must be confessed that this view rather appealed to the general belief and common sense of most people; but the legal separation was complete, according to the court, which further holds that there is no law prohibiting people from holding stock in different companies. Such a law, indeed, to control private investments, is hardly possible or constitutional, even for the most ardent reformer.

Of course, an appeal will be taken from this decision, but the high standing of the judges of the Circuit Court, and the acceptance of their earlier decisions in the same line, makes the reversal of the present one somewhat improbable. The anthracite combination is peculiar, in that few people doubt its actual existence, but it is so covered by overlapping ownerships and by nontangible alliances, that legal evidence of its existence is almost impossible to obtain. It is extremely doubtful whether the government will be able to secure any judgment of a character which will make it possible to do away with the present conditions in the trade.

The decision in the present case may have bearings of some importance on other suits which are pending under the Sherman law.

Test-Tube Metallurgy

The brilliant success of certain processes in the laboratory and their disheartening failure in the works affords constant satisfaction to the "practical," rule-of-thumb metallurgist. If the laboratory experimenter were to follow some of the rules of an eminent and commercially successful inventor, there would be fewer of these *succès d'estime* to rejoice the uneducated.

According to this practitioner, the proper way to work out a laboratory process is to think of the works first. Of what material can I build my tank to resist the solutions; how strong must my solutions be, in order that the plant may not take too much water and cost too much to build; how much wash water can I use; what chemicals are commercially possible?

Having settled that a lead-lined tank, for instance, is the only commercially feasible one, make the experiments in lead-lined tanks—the lining might have an entirely unlooked for action. Don't experiment in glass beakers unless you can put up a plant full of glass beakers; and don't experiment with tenth-normal solutions when in practice a saturated solution must be used in order not to take in all outdoors. These examples may seem childish, but count the processes you can remember which have been wrecked on just such rocks.

There is a good deal of talk as to whether or not recent attention to the prevention of accidents in mines in this country has reduced the rate of fatality. Some of our good friends are so buoyant and optimistic that they forget that Rome was not built in a day and that great reforms are not effected in one or two years. A reduction of a few points in the accident rate in one year does not indicate surely that it is going to stay reduced. It may jump up again the next year. Anyway, the statistical recording in this subject is so loose that the figures on the right-hand side of the decimal point do not count. It will be time enough to boast when a fatality rate of *about four* becomes persistently one of *about three,* and later we hope *about two.*

The experiments in coal-dust firing in connection with reverberatory furnaces that Mr. Mathewson is making, or is about to make, at Anaconda, is an interesting renewal of attention to an old but attractive subject. Mr. Sorensen's work in this direction at Highland Boy and Mr. Shelby's at Cananea, did not turn out satisfactorily, but improvements in the art may lead to better results at Washoe.

BY THE WAY

When asked recently what is going on at the property of the Bullion Coalition at Stockton, Utah, General Manager E. J. Raddatz said: "Baling hay and plowing." This is the mine which last year yielded 12,000 bushels of potatoes, says the Salt Lake *Herald-Republican*.

⁂

Engineering News reports the receipt of the following letter from Florida:

pleas give me full infomation and price complete a bout magic dips and Spanish Compas needles that finds Silver when it is burried I am intersted in this and i.ll be too glad to secure one at once a waiting your answer I am truely

Spanish needles, like goldometers, are no longer to be had, the inventor of them having been jailed by the post-office authorities. "Magic dips" will be a new entry in our catalog. We infer magic "dip needles."

⁂

The woes of the inventor are many, according to P. F. Peck. He invented a centrifugal device several years ago, for separating matte and metal from slag, but as soon as he had shown how much was being lost, the lead smelters immediately improved their technique so as to leave him nothing to do. Then as soon as he designed a centrifugal slime separator and showed how much the concentrators were losing, the multiple-deck table was brought out.

⁂

During the year there was disbursed by the trustees of the United States Steel and Carnegie pension fund the sum of $466,195. At the close of 1913 there were 2092 on the pension rolls. At Dec. 31, 1913, there was set aside from accumulated surplus of the Corporation an additional $500,000 for permanent pension-fund reserve, making a total of $2,500,000 to the credit of the fund at the close of the year. The total amount (including the foregoing $2,500,000) to be supplied by the Corporation as principal for this fund is $8,000,000, at the rate of $500,000 annually.

⁂

There has been some talk in the papers of imports of pig iron from India, and some people have referred to the probable "flood" from that quarter as disastrous to our own furnaces. It now appears that the Tata Iron Co., the only concern in a position to ship iron here, is offering pig at $13 per ton, f.o.b. Bombay or Calcutta, while the freight to the United States is $4.50. This would make the iron cost $17.50 on dock at New York. As No. 2X foundry, which is about the same grade, is selling in New York around $15, it does not look as though Tata iron would find a large market.

⁂

Ernest Mott Woolley begins in *McClure's* a series of articles on "$100,000 men," with an account of Pope Yeatman. Its characterization of this eminent and esteemed mining engineer is accurate. Some of its disclosures are quite interesting. Thus: "Mr. Yeatman lives in Philadelphia, goes to his New York office every morning, and returns home every night. He takes the seven o'clock train for New York, gets his breakfast on the train and then, in his seat in the parlor car, he works with his maps and papers until he reaches Jersey City. At five o'clock or later he starts for home again, 90 miles away. If he is late, he dines on the train; but more often he is accompanied from New York by a stenographer, to whom he dictates during the two-hour run to Philadelphia. At Wayne Junction, on the outskirts of that city, the stenographer leaves him and in a few minutes catches a return train to New York. Everybody who works with Yeatman, or for him, has the same strenuous time of it. And as for expense accounts—well, the ordinary every-day auditor or office manager would come near fainting over Yeatman's expenses. On one day recently the cable tolls were $250. In his daily career there is no luxury, such as a high salary might suggest. A lower berth in a Pullman is good enough, and a plain stateroom on a steamship. When he gets back from a hard trip in wild lands, Mrs. Yeatman orders him driven to a tailor's first of all. Personally, he doesn't like tailors. For clubs he has almost no time—a bundle of laundry has been waiting two years for him at the Rocky Mountain Club in New York."

⁂

Charles Edward Russell, the well known socialist and litterateur, in *Pearson's* for April essays with one stone to kill two birds, viz., the Calumet & Hecla "copper barons" and the Associated Press. In parallel columns he presents the latter's dispatches respecting the Calumet strike, which he claims to be distorted in the interest of the "barons" and his own version of the facts. Well informed, unbiased persons will vote, we think, that the A. P. is a better reporter than Mr. Russell. The latter is of the opinion that Mr. MacNaughton personally directed the deportation of Brother Moyer, offering the following surmise:

But part of the mob insisted that the prisoners should be taken to the railroad station, reminding the others that "Jim" was to meet them there. This plan prevailed, and the prisoners, still beaten and kicked, were dragged to the station, where a large, athletic, well dressed man in a powerful automobile awaited them. According to Moyer's story he descended from his machine, shook his fist in Moyer's face, denounced him, and said: "If you ever come back to this country I'll have you lynched!" When Mr. Moyer was able to make a statement he said that he thought that the "Jim" that supervised this lynching party was James MacNaughton, vice-president and general manager of the Calumet & Hecla. Mr. MacNaughton is a large, athletic gentleman, drives a powerful automobile, and is known to his acquaintances as "Jim." As soon as Mr. Moyer's statement appeared Mr. MacNaughton entered a vigorous denial, and the Associated Press reported that Mr. MacNaughton could not possibly have been "Jim," because the train on which Moyer and Tanner were kidnapped left at 9:27, and at 9.45 Mr. MacNaughton walked into the Miscowaubic Club at Calumet, nine miles away. On Jan. 8, three reporters in a hired taxicab covered this distance over roads heavy with snow in 22 minutes. But perhaps Mr. Moyer was mistaken in his identification of "Jim."

Presumably there are people who like to be fed with this sort of drivel, else editors wouldn't publish it. In Mr. Russell's understanding the poor miners were "exposed to the grave dangers that resulted from the rule that but one man should be employed on a drill," and "the miners whose toil produced the enormous dividends, fat salaries and colossal power of the Calumet & Hecla were ill-paid and ill-treated, often badly housed in the company's dwellings, subjected to long hours and dangerous conditions of labor." The great crime of the Calumet & Hecla company is that it has paid big dividends and that the same families have held their investment in it through half a century.

Chronoloy of Mining for March, 1914

Mar. 1—Timber-Butte zinc concentrator, at Butte, Mont., placed in commission.—Coal-mine strike in the south of France called off.

Mar. 3—Man killed by falling down a chute in the Parnell mine, at Butte, Montana.

Mar. 4—Two men killed by a fall of ground in the Salisbury mine, at Ishpeming, Michigan.

Mar. 6—Two men killed in a cave-in at the Alpena mine of the Oliver Iron Mining Co., near Virginia, Minnesota.

Mar. 8—Miner killed by fall of ground in the Crown Reserve mine, at Cobalt, Ont.—Congressional Committee investigating Colorado coal-mine strike completed taking of testimony at Denver.

Mar. 9—Congressional Committee, investigating copper-country strike, completed taking of testimony in Michigan.

Mar. 11—Two men killed by premature blast in the Old Dominion mine, at Globe, Arizona.

Mar. 12—Miner killed by a fall of rock in the Victoria mine, at Trimountain, Mich.—Miner killed by falling from a ladder in the Stanislaus mine, Jamestown, California.

Mar. 13—Archie L. Wisner and John J. Meyers convicted to six years each and Meyers in addition fined $10,000 for fraudulent mine promotion.

Mar. 13—Anaconda Copper Mining Co.'s, 20-deck round-table plant at Washoe works at Anaconda, put in full operation.

Mar. 14—Man killed by premature blast, in mine of Weedon Mining Co., at Lake Weedon, Quebec.

Mar. 16—Tsunmidato copper mine, in Japan, reported to have caved in; 300 men are said to have been in the mine at that time.—Man killed by fall in a manway in the Badger State mine, at Butte, Mont.—Hidden Creek smelting works, of the Granby Consolidated company, at Anyox, B. C., blown in.

Mar. 18—Alaska railway bill signed by President Wilson.

Mar. 19—Man struck by descending cage in the Original mine, at Butte, Mont.—Three officials of the Western Fuel Co. sentenced to terms in penitentiary for defrauding government of customs dues.

Mar. 20—Colorado Fuel & Iron Co. brought suit for $1,000,000 damages against United Mine Workers of America and various officials of the organization.

Mar. 21—First party of oil-well drillers left San Francisco for the fields in China, recently acquired by the Standard Oil Company.

Mar. 22—Man killed by a fall of ground in the Badger State mine, at Butte, Mont.

Mar. 25—Two men killed by premature blast in the Conger tungsten property, near Nederland, Colo.

Mar. 27—Anaconda Copper Mining Co. commenced construction of 2000-ton leaching plant at Washoe works at Anaconda, Mont.

Mar. 31—General closing down of coal mines in Ohio because of failure of operators to come to agreement with miners in regard to wage scale.—Erection of steel work begun by American Bridge Co. on main concentrator building of the Inspiration Consolidated Copper Co., at Miami, Arizona.

A Rich Copper Mine in Western Cuba

A remarkable copper development has taken place in western Cuba, where a copper property has been brought to a producing basis and paid a profit within one year from the time of beginning development. In recent years there have been few copper developments of this character, i.e., where the work of the first year has not only paid for itself, but returned a profit to the owner, proved an important copper deposit and warranted the equipment of the property on a commercial scale. This property is privately owned by Señor Manuel L. Diaz, a wealthy Cuban, resident in Havana, and is being developed under the supervision of C. L. Constant & Co., Bryan K. Morse being the engineer in charge.

The property is situated in the Province of Pinar del Rio, about five miles from the coast. This is a comparatively arid region of Cuba, sand and pines being the chief characteristics of the western end of the island. The copper-stained outcrops were called to the attention of present owner of the Diaz mine, who, upon the advice of the engineers, decided to investigate this deposit by driving a few exploratory adits into the hillside. The strike of the orebody is a little north of east, and the dip about 65°. The ore lies between a slate foot wall and a sandstone hanging wall. The various adits have opened first an oxidized zone, then an enriched zone of various copper sulphides and, below, a zone of chalcopyrite and pyrite containing from 14 to 16% copper over a width of 40 ft. and a length of 300 ft., so far as developed.

Development work was begun in January, 1913, and in December, a shipment was made that returned the owner over $43,000 after paying freight and smelting charges. At present, the ore is shipped from the Bay of Santa Lucia, being lightered out to steamers. The net returns from ore shipped up to April, 1914, have been over $340,000. Every cargo shipped has averaged over 20%, except the last shipment, which contained some run-of-mine material from the lower zone averaging between 15 and 16% copper, bringing the average of the cargo down to about 19%. The ore contains an ounce or two of silver, but very little gold.

A steam plant, compressor and machine drills are now on the ground, and a vertical shaft will soon be started, the extraordinary developments of last year having warranted equipping the mine for a large production. The success of the mine in Pinar del Rio has resulted in many denouncements in that part of the country. The owner of the above mentioned mine, however, has secured several thousand acres so that he is amply protected in the development of that property, and there is little chance of trouble from adjacent owners.

While there are a number of copper outcrops and ancient mines in Cuba, up to last year there has been but one producing company, the Cuba Copper Co., near Santiago de Cuba, in the southeastern part of the island. With the opening of a copper mine in the western end of the island, a development in progress in central Cuba, near Cienfuegos, and the known existence of copper deposits near the north shore, Cuba now seems destined to have further exploration for copper.

The First Sale of Diamonds from the Kongo has taken place in Antwerp, 6850 carats being sold for £9450. It appears possible that production from the numerous pipes discovered may eventually complicate the diamond situation.

PERSONALS

Allen H. Rogers has gone to Cananea, Sonora, on professional business.

George H. Garrey has returned to New York from geological field work.

Carl A. Allen has returned to Denver from the examination of mines in western Nevada.

Thomas Wilson, of Nevada, is inspecting work in progress on properties that he has in Josephine County, Oregon.

H. W. Hardinge has returned to New York from a trip through the western mining districts lasting two months.

Granville Moore, of New York, has opened offices in the Mechanics' Bank Building, San Francisco, as consulting engineer.

C. H. Palmer, Jr., of Los Angeles, Calif., is examining properties in the Slocan mining district, B. C., for eastern interests.

J. C. Anderson and F. R. Tegengrin, of the Swedish Geological Bureau, have been chosen to organize the Geological Institute of China.

Persifor G. Spilsbury, general manager of the Aguacate Mines, of Costa Rica, expects to arrive in New York about Apr. 14 on his return from the mines.

Howard F. Wierum has gone to London to make a report respecting the trial of the Hall process at the Balaklala works. He expects to return about Apr. 23.

Frank M. Leland, general manager of the Balaklala Consolidated Copper Co., has been visiting New York and Boston, attending a meeting of his board of directors.

P. McN. Bennie has severed his connection with the FitzGerald & Bennie Laboratories. The business will hereafter be carried on by the FitzGerald Laboratories, Inc., Niagara Falls, N. Y.

Morton Webber, of New York, has recently been engaged in valuation work in Montana and Idaho. He returned to New York on a short trip and has left again for the west to be absent about two months.

F. J. Galbrath and T. F. Kirkpatrick, prospectors from the Western states, are outfitting at Edmonton, Alberta, for a prospecting expedition to the shores of Lake Athabasca in the interest of Spokane capitalists.

Thomas B. Lavey, who has been for the past seven years superintendent of Isaac G. Johnson & Co.'s plant at Spuyten Duyvil, N. Y., is now general superintendent of the Standard Steel Castings Co., Cleveland, Ohio.

J. H. Cooper, of Los Angeles, Calif., formerly general superintendent of the Cia. Minera La Blanca y Anexas, at Pachuca, Hidalgo, Mexico, has been appointed manager of the Skidoo Mines Co., Skidoo, California.

R. H. Bromiy is on his way from London to the island of Jamaica to make an inspection. From Jamaica he will go to British Columbia with a similar object, and will probably be absent from London until the autumn.

Albert Freeman, formerly president of the McIntyre, who is at liberty under bail pending an appeal against his sentence to imprisonment by the United States Federal courts, is in Porcupine, Ont., inspecting the McIntyre property.

Sir Hugh Bell, the prominent English iron and steel master who now is on a tour in this country, has been the guest of honor at several functions in New York City given by E. H. Gary, chairman of the United States Steel Corporation.

J. Owen Ambler, formerly assistant superintendent at Cananea, is now metallurgist for the Calumet & Arizona Mining Co. Mr. Ambler was also in charge of the Arizona Copper Co.'s new plant under Dr. Ricketts, before it was turned over to the company.

W. P. Thornton, who has been with the Riter-Conley Manufacturing Co. for many years in various capacities, has resigned to accept a position with the Treadwell Construction Co. During the erection of the eight Gary blast furnaces of the United States Steel Corporation he was the engineer in charge.

Henry J. Kruse, of Crosby, Minn., superintendent of the Rogers-Brown Ore Co. interests on the Cuyuna Range, has resigned, effective at once. O. W. Peterson, chief clerk, has assumed the duties pending a permanent arrangement. This company operates the Kennedy, Armour No. 2, Armour No. 1 and Meacham mines.

James C. H. Ferguson, for the past 13 years Pacific Coast sales agent of the Midvale Steel Co., of Philadelphia, has severed his connection with that company and is now the Pacific Coast representative of the William Cramp & Sons Ship & Engine Building Co., of Philadelphia, with office in the Monadnock Building, San Francisco.

Thomas Hull, who has been United States surveyor general for Utah since 1905, on Apr. 1 turned over the office to I. C. Thoresen, recently appointed. During Mr. Hull's term of eight years and six months in office, there have been worked up, approved, and sent on to Washington the returns of surveys of 361 townships, embracing 5,226.808 acres of land, and 18,540 miles of lines.

Dr. Richard Moldenke, Watchung, N. J., recently sailed for Europe and will be absent until the early part of May. As chairman of the Committee on Cast Iron of the American Society for Testing Materials he will take part in the presentation of the international specifications at a meeting of the Council of the International Association for Testing Materials to be held at Turin, Italy.

James MacNaughton, general manager of the Calumet & Hecla, apparently has not lost his popularity in his home district. According to press dispatches a bitter fight was waged by the candidates of the Western Federation of Miners on Apr. 6 against the candidates on the regular tickets for township offices in the strike districts of Houghton and Keweenaw townships, but the regular tickets won by a vote of 5 to 1. At Calumet James MacNaughton was reëlected supervisor by a 10 to one vote. In only one precinct at Copper City did the federation Socialist commission win. In Allouez Township, Keweenaw County, Russell Smith, manager of the Ahmeek Mining Co., who was running for supervisor, was the only regular candidate elected.

OBITUARY

C. C. Smith, for five years principal of the Academic Department of the New Mexico School of Mines, died in Socorro, N. M., Mar. 26, following a nervous collapse. The remains were sent to Westerville, Ohio, for burial.

Arnold Becker, of New York, shot and killed himself at Grant's Pass, Oregon, Apr. 2. He was 43 years old, was a graduate of Harvard and was known as a civil and mining engineer, and manager of some placer mines in Oregon.

Ellis Miller, aged 55 years, one of the pioneers of the Mogollon mining district, New Mexico, died Mar. 25, at the Socorro Mines hospital, after a short illness. He was connected with numerous enterprises in the Mogollons and had also mining interests in Mexico. Mr. Miller was widely known and much respected in New Mexico.

Walter de Varila died in San Francisco, Mar. 26. He was well known on the Pacific Coast as a mining engineer and had been connected with several important mines. For some time he was engaged on the Panama Canal. For two years past he had been consulting engineer of the California Mines Co., and had been opening up some property in Plumas County.

Henry T. Kendall, a pioneer mining man of Fergus County, Montana, died Mar. 28, at Long Beach, Calif. He was the discoverer of the Kendall mine at Kendall, near Lewistown, where he erected one of the first cyanide plants in Montana. The mine was afterward sold to Finch & Campbell, of Spokane, who worked it successfully for many years. It is now closed down, but the operations of this mine led to the discovery of the Barnes King and other mines in the district.

SOCIETIES

American Society of Mechanical Engineers—At the monthly meeting in New York, Apr. 14, Willard C. Brinton will read a paper on "Graphic Statistics for the Engineer and the Executive."

The Eastern Iron & Steel Merchants' Association, Philadelphia, held a meeting Mar. 26, at which it was determined that the life of the organization should be continued. The meeting was the first held in eight years and its president, Frank Samuel, Philadelphia, in calling the meeting to order stated that there was an unexpended balance in the treasury. It was decided that the association could perform a useful

service as a vehicle for the joint consideration of trade problems and betterments and that the charter should be retained. Mr. Samuel resigned as president and V. L. Phillips, Philadelphia, was elected in his place.

American Electrochemical Society—The committee heads and general committee have been appointed for the general meeting of the Society, Apr. 16, 17 and 18, in New York. The preliminary arrangements are for technical sessions Thursday morning and afternoon, a smoker Thursday evening, an all-day steamboat excursion Friday, sailing around the Harbor and calling at the plants of the American Smelting & Refining Co., the United Lead Co. and the Waclark Wire Co., technical sessions at Columbia University Saturday and a dinner at the Chemists' Club Saturday night. There will be some original features and it is hoped that there will be sufficient funds available to make the entertainment gratis, with the exception of the dinner, which will be a subscription affair at a moderate figure.

Institute of Metals—At the yearly meeting in London, Mar. 18-19 the report of council was presented, and the new president, Engineer Vice-Admiral Sir H. J. Oram, delivered his address. He referred especially to the declining use of copper and other nonferrous metals in shipbuilding. The following papers were read: "Bronze," by John Dewrance. "Vanadium in Brass: The Effect of Vanadium on the Constitution of Brass Containing 50 to 60% of Copper," by R. J. Dunn and O. F. Hudson. "The Quantitative Effect of Rapid Cooling upon the Constitution of Binary Alloys. Part II," by G. H. Gulliver. "The Influence of Nickel on Some Copper Aluminum Alloys," by Prof. A. A. Read and R. H. Greaves. "The Micro-Chemistry of Corrosion. Part II. The a-Alloys of Copper and Zinc," by Samuel Whyte. "Muntz Metal: The Correlation of Composition Heat, Heat Treatment, Structure, and Mechanical Properties," by J. E. Stead and H. G. A. Stedman.

INDUSTRIAL NEWS

The Allis-Chalmers Manufacturing Co. of Milwaukee, Wis., has been licensed to manufacture and sell the McGregor patent skullbreaker.

Fred B. Smith has been appointed assistant to the president of the H. W. Johns-Manville Co., New York. For many years Mr. Smith has been Secretary of the International Committee of the Young Men's Christian Association.

The United States Steel Corporation has appropriated $400,000 for a byproduct plant at Farrell, Penn., to refine coal tar and produce crude gasoline. This is the first plant of its kind the Corporation has yet undertaken. Heretofore at Farrell only coal tar and sulphate of ammonia have been made.

The Morse Bros. Machinery & Supply Co., of Denver, has purchased the entire equipment of the Yampa Smelting Co. at Bingham Cañon, Utah. This was a 1000-ton daily capacity copper smeltery with converter plant, erected in 1908 and operated about one year. The plant will be dismantled and all of the material offered for sale.

The National Smelting & Refining Co. has been established by the Cohen-Schwartz Rail & Steel Co. and L. J. Cohen & Co., of St. Louis, Mo., and is owned by L. J. Cohen, William Lewin and H. Cohen. This company has installed a reverberatory furnace to run down drosses, and machinery to manufacture a full line of metals, such as spelter, solder, babbitts, plumbers' and printers' metals. The company will be in the market to buy all grades of drosses and white-metal scrap.

Otto Coking Co., Inc., has been formed to operate in the United States, and on Mar. 1, 1914, took over the organization, assets and good will of the Schniewind Coke Oven Co., the United Coke & Gas Co., the German American Coke & Gas Co., and the American Coke & Gas Construction Co. The Otto Coking Co. is controlled by the interests in Dr. C. Otto & Co., of Dahlhausen a. d. Ruhr, Germany, and the Otto Byproduct Coke Co., of Leeds, England. The object is to introduce into the United States the Otto Regenerative Byproduct Coke Oven, with direct recovery of ammonia, tar and benzol. The new company starts out with a contract for the immediate erection of a plant for the Buffalo Byproduct Coke Corporation at Lackawanna, New York, near Buffalo, with several other negotiations now going on for additional plants.

The temporary offices of the corporation will be at No. 6 Church St., New York City, where they occupy the entire seventh floor.

NEW PATENTS

United States patent specifications may be obtained from "The Engineering and Mining Journal" at 25c. each. British patents are supplied at 40c. each.

ALUMINA—Method of Making Alumina. Herbert T. Kalmus and Walter L. Savell, Kingston, Ont., assignors to said Kalmus. (U. S. No. 1,090,479; Mar. 17, 1914.)

BLAST-FURNACE STACK (Air-Cooled). John J. Shannon, Birmingham, Ala., assignor of one-third to James P. Dovel, Birmingham, Ala. (U. S. No. 1,090,574; Mar. 17, 1914.)

BLAST-FURNACE TUYERES—Improvements in Blast-Furnace and other Tuyeres, Coolers, or Water Blocks. W. J. Burnyeat, Whitehaven; W. Concur, Brigham, Cumberland; R. Sibbald, Distington, Cumberland; and John Lochhead, Distington, Eng. (Brit. No. 13,838 of 1913.)

BORAX—Manufacture of Borax and Boric Acid. Ernest Laremont Fleming, Chester, England. (U. S. No. 1,090,526; Mar. 17, 1914.)

CRUSHING ROLL. Thomas B. Crowe, Colorado Springs, Colo., assignor to Portland Gold Mining Co., Colorado Springs, Colo. (U. S. No. 1,090,601; Mar. 17, 1914.)

CYANIDING—Improvements in and Relating to Processes of Precipitating and Separating Metals from Solutions. R. S. Towne, New York, and C. Robinson, Mount Vernon, N. Y. (Brit. No. 4807 of 1913.)

DREDGE BUCKET. Frank Z. Hunt, Breckenridge, Colo. (U. S. No. 1,090,478; Mar. 17, 1914.)

DRILL CHUCK. Victor R. Koontz, Waynesboro, Penn. (U. S. No. 1,091,886; Mar. 31, 1914.)

DRILL SOCKET. Robert G. McDowell, Walkerville, Mont., assignor of one-fourth to Robert B. McIntyre, Walkerville, Mont., and one-fourth to Martin F. Gilligan, Butte, Mont. (U. S. No. 1,089,660; Mar. 10, 1914.)

DRILLS—Drill-Spindle-Rotating Mechanism for Close-Corner Drills. Caid H. Peck, Athens, Penn., assignor to Ingersoll-Rand Co., Jersey City, N. J. (U. S. No. 1,089,437; Mar. 10, 1914.)

FLUORSPAR—Process of Purifying Fluorspar. Ernest Bidtel, Golconda, Ill., assignor to Moritz Eyssell, St. Louis, Mo. (U. S. No. 1,091,795; Mar. 31, 1914.)

HARDNESS OF METALS, Machine for Measuring Directly. René Guillery, Paris, France. (U. S. No. 1,091,128; Mar. 24, 1914.)

IRON AND STEEL—Process and High-Pressure Furnace for the Direct Production of Iron and Steel. Carl Otto, Dresden, Germany. (U. S. No. 1,089,951; Mar. 10, 1914.)

MAGNETIC SEPARATORS, Improvements in and Relating to. Bowes, Scott & Western, Ltd., and I. S. Dalgleish, London, Eng. (Brit. No. 3046 of 1913.)

NICKEL—Recovery of Nickel from Its Ores. H. L. Sulman and H. F. K. Picard, London, Eng., assignors to the Madagascar Minerals Syndicate, Ltd., London, England. (U. S. No. 1,091,545; Mar. 31, 1914.)

OPENHEARTH FURNACE. Oscar Simmersbach, Breslau, Germany. (U. S. No. 1,090,503; Mar. 17, 1914.)

ORE CLASSIFIER. Charles O. Michaelsen, Omaha, Neb. (U. S. No. 1,090,326; Mar. 17, 1914.)

ORE COOLER. Frederick Laist, Anaconda, Mont. (U. S. No. 1,090,549; Mar. 17, 1914.)

PANNING AND CONCENTRATING MACHINE. Charles Anderson Case, New York, N. Y. (U. S. No. 1,090,448; Mar. 17, 1914.)

REFINING STEEL. Axel Hethey, London, England. (U. S. No. 1,089,410; Mar. 10, 1914.)

ROASTING—Electrical Heating Device for Metallurgical Furnaces. Utley Wedge, Ardmore, Penn. (U. S. No. 1,088,496; Feb. 24, 1914.)

SEPARATOR for Gold. Herbert P. Ewell, Detroit, Mich. (U. S. No. 1,091,917; Mar. 31, 1914.)

SHAFT LINING—Method of Lining Shafts with Concrete. Edward Morlae, San Gabriel, Calif. (U. S. No. 1,089,573; Mar. 10, 1914.)

SLAG—A New Process for Pulverizing Blast-Furnace Slag and the Like. E. A. Bagley and M. E. Fellmann, London, Eng. (Brit. No. 4018 of 1913.)

SLAG-HANDLING APPARATUS. Rocky C. Gangewere, Selma, Ala. (U. S. No. 1,091,828; Mar. 31, 1914.)

STEAM SHOVEL—Dipper-Tooth and Clamp. Edward Webb and Vernon Keech, Virginia, Minn. (U. S. No. 1,087,621; Feb. 17, 1914.)

TIN—An Improved Automatic Process for the Recovery of Tin or Other Ores from Rivers, Waste Sands and the Like. W. J. Hocking, Camborne, Cornwall, Eng. (Brit. No. 10,936 of 1913.)

TIN—Method of Recovering Tin. William Hoskins, Chicago, Ill. (U. S. No. 1,088,422; Feb. 24, 1914.)

ZINC—Apparatus for Magnetizing Desulphurized Ores. George Sage Brooks, Depue, Ill., assignor to Mineral Point Zinc Co., Depue, Ill. (U. S. No. 1,090,516; Mar. 17, 1914.)

ZINC—Electric Zinc Furnace with Integral Condenser. John Thomson, New York, N. Y. (U. S. No. 1,090,427 and 1,090,428; Mar. 17, 1914.)

ZINC—Universal Electric Furnace, Combined with Means for Condensing Zinc. John Thomson, New York, N. Y. (U. S. No. 1,090,429; Mar. 17, 1914).

ZINC—Separation of Metals from Zinc-Bearing Ores or Compounds. Edgar Arthur Ashcroft, Balestrand, Sogn, Norway. (U. S. No. 1,091,269; Mar. 24, 1914.)

Editorial Correspondence

SAN FRANCISCO—Apr. 3

Conviction and Sentencing of Wisner and Myers for using the mails to defraud purchasers of mining shares will have good effect in California, where these men operated. Six years' imprisonment at Atlanta and the payment of $10,000 fine each imposed by the U. S. district court in New York, should be sufficient warning to other fake promoters of California mines. In fact a former trial, though it resulted in a jury disagreement, effected a noticeable dimunition in the performances of this class of swindlers. During the time that Myers carried out the fraudulent schemes of A. L. Wisner & Co., from the San Francisco offices of the company, there were a number of smaller swindlers operating in a similar manner, who have since been frightened off. In their place a different class of mining stock swindler has appeared, who avoid the use of the mails by selling shares in mining properties by personal appeal or through agents. These men are hard to reach because there is no governmental departmnt behind the prosecution, and the evidence of fraud is commonly secured by the individual effort of the victims, who in most cases would rather have their money returned than to send the swindlers to prison.

The Mine Safety Bureau in California, established by the U. S. Bureau of Mines, to be maintained jointly by the Government and California, is in operation. Hugh M. Wolflin, of the Bureau of Mines, who was appointed chief, is at present visiting mines in the Mother Lode region and making recommendations to mine owners and superintendents regarding necessary safety equipment. The office of the safety bureau is in the Underwood building, San Francisco. Mr. Bromwell, chief safety engineer of the California Industrial Commission, is the other member of the bureau, whose duties relate chiefly to the safety of factories and other industrial establishments outside of mining. California has no mine-inspection law, but Mr. Woflin is expected to act under the rules of the Bureau of Mines and to insist upon compliance with such laws as are provided by the state for the safety of miners. These laws include: Coal-mine regulation; control of explosives; fencing abandoned shafts; hours of employment underground; mine-bell signals; mine exits; telephone system in mines; workmen's compensation. The last-named law, which was passed by the legislature of 1913, makes no special provision for the safety of miners and offers no suggestion to the mine owner as to any proper system or method, but demands heavy compensation without adequate relief for the mine owner. It was supposed that the state compensation insurance fund, which is a part of the industrial commission, would undertake insurance risks in behalf of the mine owner as well as other industrial employers amenable to the law; but the commission has declined to take large risks and has practically excluded all mines from the benefits of the fund. The reason is logical. The chance of 50 or 100 miners being locked up in a mine by fire or caving, and being brought out with a large death list looked like too big a chance for an insurance fund of $100,000 appropriated by the state; so the commission passed up the mines to the insurance companies and corporations, who may as logically pass them back. Of course, some of the insurance companies will write underground mine insurance, but under the demands of the workmen's compensation law they are obliged to make a stiff rate. The state insurance fund might as logically refuse to take risks on some of the large industrial plants that employ from 50 to 250 men and women. But the fund has largely increased since the commission has been in operation by reason of the large total amount of premiums paid in; so, as the commission has expressed recently, the fund can now stand a large loss. However, the fact still remains that the state will not write underground insurance for more than $10,000 on any one risk, and if the insurance companies adopt the same rule the prospect for the mine owners is not encouraging.

DENVER—Apr. 2

Moffatt Tunnel is a popular topic for discussion. Contracting firms are making estimates preparatory to the anticipated advertising for bids. The tunnel commission's engineers specify that the excavation will amount to 499,200 cu. yd. of rock. Inasmuch as the City of Denver will own the tunnel and may wish to utilize it in conveying water from the Pacific watershed for municipal supply, cross-section of the bore will be so arranged as to permit the laying of large pipes. This may possibly be done with a single large bore but it is being suggested that the best plan will be to drive a smaller tunnel parallel to the main tunnel, with frequent crosscuts. This would expedite the haulage of waste, an important consideration in a bore of the length proposed, and it will also assure better ventilation.

Another Tale of a Lost Mine is being circulated. It comes from Breckenridge, and while the name of the hero has been lost, as usual, the story is "well authenticated." According to this narrative, a prospector of the early '80's, while eating lunch one day, broke a fragment from a vein and finding it attached by some interesting metallic threads, took the chunk with him to town. An immediate snowstorm obliterated his track. Arriving in Denver, he disposed of the specimen for $470. He spent the succeeding summer in a vain search. Mouth-to-mouth record has placed the find about 7 miles south of and within view of town, and below timberline. The story affords a good excuse for an outing with an incentive.

Unwatering "Downtown" Leadville Mines, the proposition explained in these columns in the "Journal" for Feb. 7, is now assured. Jesse McDonald's plan is working out exactly as then announced and the St. Louis men who are backing him have incorporated the Downtown Mines Co. with the following directors: J. L. Goff, W. T. Nardin, C. W. Chamberlain, J. C. C. Waldeck and C. J. Walker. Capitalization is $300,000. Every important contract with the owners of the numerous properties that became amalgamated in this deal has been signed with the exception of a few that have been pledged and are merely awaiting the formalities of directors' meetings. The area that will be rendered workable under this scheme has been idle since 1907 and includes the following mines: Colorado, Star Consolidated or Elk, Niles-Augusta, Dillon, Midas, Gray Eagle, Pocohontas, Penrose, Orion, Bison, Sixth Street, Alice placer, Star, Bon Air, Weldon, Morocco, P. O. S., Sizer placer and the S. Small. Twenty-year leases have been obtained on these properties with a total area of about 400 acres. The geological horizon to be exploited is known to contain galena-silver ore as well as masses of smithsonite, the value of which had not been recognized when these mines were last worked.

NEGAUNEE—Apr. 4

Improvements at the Tilden are being planned by the Steel Corporation for this mine at Bessemer, on the Gogebic range. One part of the new work will be the sinking of a shaft, the lining of which is to be of steel and concrete. Another project is the erection of an engine and boiler house and a coal dock and trestle. These structures will be built south of the No. 10 shaft. Excavation is in progress there in solid rock.

Restoring the Kloman Mine to Activity is in prospect. Interests represented by George A. Finney, of Chicago, are said to be associated in the project. The Kloman, idle for years, was reopened in part by John T. Jones, of Iron Mountain, three years ago, and one of Jones' step-process furnaces was erected to treat the ore, which is low grade and at present not marketable. The Jones interests suspended operations and transferred their activities to a larger field in Utah. Finney also is reported to have worked out a process for treating low-grade ores and, according to the understanding at Republic, there is excellent prospect of his method being given a test at the Kloman.

A Change in the Grange Leaders' Attitude toward mine taxation is said to have been made. Instead of resorting to the initiative, it is now proposed to make an attempt to pass a bill in the 1915 legislature. The grange leaders believe they will have the requisite votes; but if the legislature again refuses to sanction the proposed measure the plan first contemplated will be revived. One of the arguments against initiation was the improbability that the proposal would receive disinterested consideration, in light of the feeling created, because of the long-drawnout copper-country strike. Leading grangers admitted there was merit in this contention and it is said to have had influence in changing the program. But the big organization of Michigan farmers has not dropped the tonnage tax idea. The measure will be put forward in the next legislature and will probably take rank with the prohibition question as the greatest issue of the session.

Cleveland-Cliffs Drilling is persistent, and the company at all times has diamond drills in commission. Exploration has been conducted in the Iron River and Crystal Falls fields of the Menominee range the last few years and ore has been located but is as yet undeveloped. Four drills on the Marquette range, in which district the company is the largest producer, are at work in the country west of Ishpeming, three on the west shore of North Lake and one on the tract known as the Peterson farm. One or two will be added to this number when the old Dexter mine, seven miles west of Ishpeming, is unwatered. The Dexter, long idle and previously wrought by other interests, is held by the company under lease. Men have been retimbering the shaft down as far as the water level, 30 ft. beneath the surface, and pumping will soon be in progress. The shaft is 650 ft. deep. With the workings drained and retimbered and otherwise made safe, diamond-drill exploration will be conducted from the bottom level in the hope of encountering merchantable bodies of hematite. The Dexter probably will be wrought from the shaft of the Chase mine, in the event the discoveries warrant mining work. The Chase is a new property, adjoining on the east. Electrical transmission and pipe lines have been extended to the Dexter and other preparations made for the proposed operations.

MARQUETTE—Apr. 3

Graduates from the Chapin Mine, the Menominee range's biggest producer, and one of the big mines of the Steel Corporation, are being recalled now on the twenty-fifth anniversary of its purchase by Ferdinand Schlesinger, who afterward sold it to the Steel Corporation. Several men who have since attained prominence in industry and finance once held positions at the Chapin, among them being Thomas F. Cole, of Duluth, now a copper mine owner and formerly president of the Oliver Iron Mining Co., the Steel Corporation's Lake Superior subsidiary, who held the position of cashier in the Chapin office. James MacNaughton, of Calumet, general manager of the Calumet & Hecla and other Lake Superior companies, was the mining engineer. A clerk in the office was Frederick Wheeler, who for several years past has been president of the American Can Co. Another clerk was John H. McLean, now in Duluth, where he holds the position of general manager of the Oliver company. George J. Eisele, formerly the stenographer and still of Iron Mountain, is assistant superintendent of the Steel Corporation's mines on the Menominee range. As a training school, the Chapin mine has a record unsurpassed in the Lake Superior region.

DULUTH—Apr. 4

New Shipping Facilities in 1915 will include the new steel and concrete pier of the U. S. Steel Corporation's Duluth, Missabe & Northern system at Duluth and a similar structure to be built at Ashland by the Soo Line. The Duluth dock, the construction of which is well under way, will be 2304 ft. long and will cost approximately $2,000,000. The Soo Line pier at Ashland will involve an expenditure of $1,000,000. Work on this will be started soon. Other important improvements contemplated by the Soo Line in connection with the Gogebic iron-range traffic include the construction of a second concrete dock in 1916, this to take the place of the present wooden pier; the building of a more direct line to the mines, the enlargement of the receiving yards and roundhouse and the installation of additional rolling stock. Last year the Northern Pacific entered the ore traffic for the first time when it put into commission a newly erected dock at Superior. Only two cargoes were shipped, however. This year the road will haul a large tonnage, all of which will come from the Cuyuna range, in the business of which the Northern Pacific and the Soo Line share, the latter also with a dock at Superior. Both companies will put much new rolling stock in commission. The Northern Pacific has recently extended its Cuyuna line to Rogers, Brown & Co.'s Kennedy mine, heretofore served by the Soo Line exclusively. Another Northern Pacific extension will be from the Cuyuna-Mille Lacs mine to the Duluth-Brainerd property. The builder awarded this contract will be required to have the line ready for service by June 30. The Duluth-Brainerd shaft is sinking and the mine will be prepared to make its initial shipment early in the summer.

JOPLIN—Apr. 4

Specimens for the Exposition at San Francisco have been assembled from the Galena, Kan., district for use as an advertising display with a six-car "booster" train to leave southeastern Kansas on Apr. 12. The train will touch most of the principal cities of the East. The specimens collected by the Galena Commercial Club are thought to be the finest ever sent out of the district; their weight exceeds one ton. All of the large properties contributed samples both of blende and galena.

Chance in Prospecting is an element not to be deprecated. Recently it played a part in locating an ore deposit near Miami, Okla., when ore was found on the farm of J. A. Souththat. Drillmen were removing drilling apparatus that, when passing the farm, became stuck in the mire. The condition of the earth indicated to the drillmen that there was a chance of finding ore there. The drill, which could not be moved farther toward its intended destination, was backed out to the Souththat farm. A 20-ft. face of zinc and lead ore was encountered at a depth of 200 ft. More holes are to be put down.

Farming on Mine Land is to be brought about through efforts of the Commercial Club. Mining lands in the immediate vicinity of Joplin are to be devoted to agricultural purposes for the first time. The club has arranged with land owners to lease the surface rights of their property for farming, retaining the privilege, of course, of mining when desired. Most of the area has been worked underground at some time, but approximately 30,000 acres have laid idle, a major part of which will now probably be tilled through the Commercial Club's plan to see the Joplin district produce more farm products, thereby waging somewhat of a battle against the high cost of living. Two farm experts from the University of Missouri have been here this week, testing soil near the city. They pronounced the soil adapted to most grains, vegetables and fruits raised in the Middle West.

SILVER CITY, N. M.—Mar. 28

A Custom Sampling Plant in Silver City is being planned and will be built if a suitable site can be obtained. The promoters are well known mining men engaged in operations in the Southwest. According to reports their plan is to establish the sampling plant and ultimately construct reduction works in connection with it. The men behind the plan have visited the various mining camps about Silver City and have found that a sampling plant is needed and that Silver City will be central for a great many districts.

VANCOUVER—Apr. 2

Geological formation of Chisana District, in Alaska, is dominantly sedimentary, and consists of dark gray to black shales and slates, which are extensively invaded by basic volcanics, which occur in the form of dikes less than 100 ft. thick. The strata of the prominent easterly-trending range in which the gold-bearing creeks head, and which are undoubtedly the source of the placer gold, have been highly mineralized as a result of the igneous invasion and have a general bright-red color throughout, due to leaching and oxidation of the contained iron minerals, states Dr. D. D. Cairnes, of the Dominion geological survey. A number of the present streams have comparatively recently formed cañon-like valleys, and in places the material of the older stream channels is quite apparent and the gravels they contain constitute the main bench gravels. From these gravels it is possible that the bulk of the gold will be obtained. A small area, not exceeding 12 square miles, is known to contain important deposits of placer gold. Recently a strike was made at the mouth of Chatenda Creek, which is reported to be rich. The geological formation and the general conditions persist eastward well into Canadian territory for 30 or 40 miles.

JOHANNESBURG—Mar. 8

East Rand Mines Continue To Attract Attention as they have been doing of late. During the last three months of 1913, the Van Ryn Deep crushed 105,700 tons for a return of £1 13s. 5d. per ton, with working costs of 19.14s. per ton. Development over 1349 ft. showed reef averaging 24.8 dwt. over a width of 20 in. The Geduld Proprietary has 1,757,000 tons of ore developed, assaying 6.9 dwt. over 58 in., with 106,000 tons partially developed. This mine needs a new deep shaft and a large crushing plant. Its area is nearly 3000 acres. The government gold mining areas are developing an area of about the same size by four vertical shafts. The erection of a mill to crush 50,000 tons per month, has been begun. A fair portion of the reef is rich and it is expected that crushing will start at the end of the year. The Modder Deep owns a triangular area of 400 acres lying between the Van Ryn Deep, New Modderfontein and government mining area. It is estimated that 6,800,000 tons of ore will be produced from this area which is developed from two 3-compartment shafts placed close together near the center of the area; 13,147 ft. of workings in ore assay 8.9 dwt. over a width of 45 in.; 1,000,000 tons are developed, valued at 7 dwt. over 75 in., with 200,000 tons partially developed at 10.5 dwt. over 62 in. A mill of 60 stamps and six tube mills is being erected to crush 360,000 tons per year.

The Mining News

ALASKA

UPPER DOME is one of the busiest portions of Fairbanks district. Outfits are at work on Discovery, No. 2, 3, 4, and 7 Below, and all are reported to be in pay. On claim No. 3 Above a pillar is being mined that is said to contain 12,000 sq.ft. of bedrock, dirt sluicing $1 per sq.ft. On No. 6 Above, Falls & Michaely are in pay with their second shaft, which reached bedrock Feb. 7.

GOLD-BEARING QUARTZ AT CHISANA has been found and that fact is bringing the district into better esteem among the prospectors. It is significant that no one has yet returned to "knock" the camp. It is believed by many who have been to the district that even if the placers should be found not to extend over a wide area, quartz mines will be opened. With the coming of warmer weather prospectors will get away from the original discovery and find just how far the district does extend. Men now in the camp are working timber for sluice boxes. The men in camp are working to reach bedrock. The ground is mostly thawed and water has kept the miners back. There are many miners with years of experience in other interior camps who are preparing to work there next summer and have spent the winter getting up wood and making other preparations. The trail is now in excellent condition and practically no trouble is experienced in reaching the camp from any part of the country.

ALASKA MEXICAN (Douglas)—February production from 17,850 tons, $2.24 per ton, or $39,632; net profit, $8518.

CRITES & FELDMAN (Meehan, via Fairbanks)—Only three men are working on claims on Fairbanks Creek. Development of these promising claims is hindered by lack of proper milling facilities. All ore milled is hauled to Willis mill on Chatham Creek at a cost of $6 per ton. This, added to milling cost of $8 per ton, prohibits shipping of low-grade ore. Only enough selected ore is shipped to pay expenses. Meanwhile, mine is being opened in excellent manner, and should soon become a steady producer.

RELIANCE MINING CO. (Olness, via Fairbanks) — Soo claim, at head of Dome Creek, owned by Reliance company, is under lease to Brumbaugh & Spaulding. East drift on 100-ft. level has been driven several hundred feet. Three stopes have been opened, but ore in these is exhausted. Last 150 ft. of drift is in barren ground, though vein continues. A crosscut is being driven from a point 100 ft. east of shaft to tap so called "big vein" that outcrops 100 ft. uphill from smaller but richer vein on which most work had previously been done. Crosscut has advanced 85 ft. Small mill at mine is operated whenever there is ore. November and the December cleanups each returned $1500, while January cleanup was $500. No profitable ore is now coming from mine, but from orebins is being drawn a small supply that was intended for large mill on Dome Creek. Mine has produced more than $80,000, mostly from 50-ft. level. It is planned to sub-lease mine in small blocks.

NEWSBOY (Cleary City, via Fairbanks)—December cleanup of mill was $2500; January cleanup was $4500. Operating expenses totaled $5000 for December and $4000 for January. Owing to poor showing in December, directors were given authority at annual meeting of stockholders, Jan. 5, to close mine if January showed no improvement, it being general belief that expected passage of Alaska railway bill, then before Congress, and building next summer of proposed power plant on Totatlanika River, would result in a great reduction of mining costs. Mine was closed Feb. 1, but at a subsequent meeting of directors it was decided to lease mine to crew, who will work it on a coöperative basis. By terms of agreement lessees are required to pay to company a royalty of 25% of gross output. They have use of all machinery at mine, including hoist, air compressor, machine drills, fan, etc., and also of 5-stamp mill at head of Cleary Creek. Lessees purchased wood on hand for $1000 cash. According to report of the general manager, L. M. Drury, there is enough ore developed of an assay-value of $20 per ton to supply mill for three months, 1800 tons. It is understood that Mr. Drury will act as manager for lessees.

ARIZONA

Gila County

SOUTHWESTERN MIAMI DEVELOPMENT CO. (Miami)—Churn drilling is progressing at a good rate of speed. Hole No. 14 A. has reached a depth of 915 ft. At No. 17, machine has been idle, due to lack of some casing tools. This hole is now 1268 ft. deep and is being watched with considerable interest throughout district as it is located on Montezuma group and a discovery of ore at this point would be indicative of a greatly increased tonnage for company.

IRON CAP (Globe)—Drifting on 800-ft. level along foot wall of vein is being done—both east and west from crosscut which showed excellent ore. A total distance of 50 ft. has been driven to date. Ore is being left in place and preparations are now under way to commence stoping. Winze being sunk from 650-ft. level is 80 ft. deep, bottomed in good ore. Drifting on 800 to make connection with this winze is being pushed rapidly and connection should be made within 25 days.

INTERNATIONAL SMELTING & REFINING CO. (Miami)—MacArthur Bros. have nearly completed excavating for power plant and cooling tower near smelter site. In its general design, this plant will resemble closely that of Miami Copper Co. in that boiler plant and power house are to be under separate roofs with stack between them. A cooling basin, however, instead of a tower is to be used to conserve boiler-feed water but this difference is due mainly to topographical features. Capacity of plant will be 18,000 kw. Foundation for 20x300-ft. steel stack at smelter is now being poured. Footing is 58 ft. in diameter and goes down a depth of 10 ft. to a solid bearing. Foundations for machine shop tools are nearly completed as are also foundations for the reverberatories. Smelter site is soon to be surrounded by a wire fence, several men having been engaged for the past three weeks molding 320 reinforced-concrete posts which will support fencing.

INSPIRATION CONSOLIDATED (Miami)—Erection of steel was commenced on concentrator building, Mar. 31. There are approximately 3000 tons of steel to be erected. Nearly all of the foundations for large machine tools at concentrator shops are now in place and various lathes, mills, rolls, etc., and will soon be set in position so cement floors may be laid. All equipment in shops is of latest type and an idea of its completeness can be gained from the fact that in machine shop alone there will be 18 power-driven tools while in forge shop there will be installed five machines for work requiring heat treatment. Locomotive repair pit will also be in this shop. In an annex will be several modern wood-working machines as well as a turntable for locomotives. There will be several jib-cranes in shops and a 40-ton overhead traveling crane for heavy machine parts. Machine parts that must be sent to shops for repair will be moved by a traveling crane Each loft of concentrator will be served by such a crane and these cranes in turn will connect with a skip operated by an electric hoist and running in an inclined skip-way on east side of concentrator building. This skip-way runs directly to shops. A temporary transformer station is nearly ready to go into commission so that from now on power will be taken directly from Roosevelt line instead of from concentrator transformer station transmitted over company's line. Line held in reserve to be used only in cases of emergency has been tested out and found to be in good working order. Unless some unusual accident should occur, it is now reasonably certain that the government will be able from now on to furnish continuous power.

Mohave County

PIONEER (Oatman)—Group recently changed hands and new owners have taken possession and begun work.

TENNESSEE (Chloride)—Mine is sending to surface 110 tons per day of $40 ore. Development work on 900-ft. level is showing excellent ore.

BIERCE & McNEELEY (Mineral Park)—A crosscut has been driven from bottom of a winze 175 ft. below main drift. Vein is 40 ft. wide at this point. Another winze is to be sunk from same drift and two will be connected.

GRAND GULCH (St. George, Utah)—Property is now shipping 125 tons of ore per month to Utah smelters over St. Thomas branch. Ore assays up to 20 or 25% copper. On 250-ft. level 3 ft. of high-grade copper ore was recently opened up.

Yavapai County

ARKANSAS & ARIZONA (Jerome)—Company is grading for a standard-gage railroad down cañon to mouth of 1000-level tunnel of United Verde company, where there is a standard-gage road completed to new smelting plant at Clarkdale.

CALIFORNIA

Amador County

IONE COAL & IRON CO. (Ione)—It is reported that negotiations are in progress for disposal of coal output of company's mine to a syndicate for manufacture of fuel briquettes. There is a present local market for coal as it is mined.

Butte County

FRENCHTOWN, one of the early-day rich placer mining camps of county has been figuratively taken off the map by removal of one surviving pioneer, N. C. Reynolds. After placers had been exhausted Reynolds turned to farming. At age of 82 he has sold his ranch, which was once his mine, and retired from active labor.

Nevada County

GOLDEN CENTER (Grass Valley)—High-grade ore is reported to have been disclosed by development. Ore is being sacked and shipped to Selby. Medium-grade ore is being milled.

Placer County

GOLD RUN DRIFT MINES (Gold Run; Owner, J. D. Stewart)—Machinery for electric power is on ground and installation is in progress. This is one of the largest gravel mines of northern California, which was worked for many years by hydraulic and drift methods.

San Bernardino County

LEOTI (Dale)—It is reported that mine has been taken under purchase bond by men who will undertake extensive development. Price is said to be $30,000.

AMERICAN TRONA CO. (Searles)—It is expected that installation of new plant will be completed and ready for operation by middle of April. New railroad from Garden station on Southern Pacific is nearing completion.

PARADISE MOUNTAIN MINING CO. (Barstow; Secretary, John C. Campbell, San Bernardino)—San Francisco men are negotiating for purchase of mine and mill 22 miles north of Barstow. A large amount of development has been done and a good showing of low-grade ore blocked out.

COLORADO

Clear Creek County

GRAND CLEAR CREEK CO. (Empire)—Crosscut tunnel has intersected a vein 35 ft. wide.

MALM MILL (Georgetown)—This plant intended to demonstrate Malm chlorination process, after lying unfinished for a number of years, is to be immediately completed. It will be general testing plant for this method of treatment and its first run will be upon a large lot of ore to be shipped from Bunker Hill & Sullivan mine, Kellogg, Idaho. Plant has already cost about $100,000 and requires now chiefly electrical equipment.

La Plata County

CAVE BASIN DISTRICT is described as follows in a circular now being sent out by the Denver & Rio Grande R.R.—Cave Basin is 20 miles north of Bayfield, on divide between Pine and Vallecito Rivers, at an elevation of 10,000 ft., and can be reached from Ignacio, on Denver & Rio Grande R.R., 26 miles east of Durango. At Ignacio connection can be made with an automobile stage line running directly to camp and through Bayfield, where all kinds of supplies and camp equipment can be obtained. Geology—Formation, similar to that at Clifton and Bisbee, Ariz., consists of a sheet of limestone from 100 to 1000 ft. thick, and sandstones, shales, and thin bedded limestones, of carboniferous period. Limestone covers an area of 50 square miles. Underlying this limestone is a sheet of quartzite from 200 to 600 ft. thick, both limestone and quartzite dip at an angle of about 30° to southwest. Underlying quartzite is a metamorphic granite. Several large faults run through Basin in an easterly and westerly direction and a system of veins and dikes having a north and south strike cut through limestone. Ore Deposits—So far all ores have been found in limestone in form of carbonates, chalcocite and bornite. Ores mined have assayed $75 to $100 per ton, two-thirds in silver and one-third in copper, with from $3 to $5 in gold. Ores mined to date have been found in bedding planes of limestones but near verticals. As yet contact between limestone and the quartzite has not been explored, and it is reasonable to suppose that here is where larger bodies of ore will be found. History—First important discovery of ore in Cave Basin was made late in August, 1913, on Dowell property. Ore was discovered in a shaft at a depth of 20 ft. From this prospect four or five small shipments of from two to five tons each, were made, worth $75 per ton. At same time Acord property and Tom Boy, both three miles north of Dowell property, were discovered and several small shipments of ore assaying $100 per ton were made from each. High-grade float of same character as found on Dowell, Acord and Tom Boy properties can be found in wash in many places throughout camp, making it appear that ore deposits extend over a large area. Considering small amount of work done so far, and high grade of ore found to date, it would seem as though this new camp should develop rapidly. Economic Conditions—Cave Basin lies at head of Pine River valley, noted for its rich agricultural and grazing lands. At head of this valley, within a few miles of mining camp, there is a 20-ft. vein of coal of the best quality. Cave Basin country is covered with heavy timber suitable for mining and lumber purposes, and Pine and Vallecito Rivers could furnish an abundance of power. There are good roads to camp which are accessible at all times of the year. Bayfield, a town of 500 inhabitants is in heart of this valley, which can supply camp with food products and supplies of all kinds.

Lake County

FOREST CITY (Leadville)—Workings are now unwatered and are being repaired. Development of new ground will begin as soon as conditions permit.

PEERLESS (Leadville)—A tunnel is being driven in this St. Kevin district property to drain upper formations that are presumed to carry high-grade silver ore.

LACKAWANNA STAR (Twin Lakes)—A new incorporation known as Lackawanna Star Gold Mining Co., with a capitalization of $500,000, will work a group on Sunset Mountain Incorporators are E. F. Jewett, H. F. Bowen and E. C. Hiatt and main office will be in Cañon City.

MAY QUEEN (Leadville)—Harris & Co., lessees, have shipped 200 tons from a new find of smithsonite running from 37% to 42% zinc. They are blocking out a large tonnage of 20% ore with intention of shipping to local zinc plant now in process of erection.

NISI PRIUS (Leadville)—Buildings at this property that has been shut down for a long time have been repaired by Martinelli & Gau, lessees, who have also erected new machinery. Exploration will be for large masses of zinc carbonate that are supposed to exist in this ground.

WESTERN ZINC MINING & REDUCING CO. (Leadville)—This new company, capitalized at $50,000, has broken ground for erection of first 50-ton unit of its proposed 200-ton smeltery. The first unit will comprise eight Wetherill furnaces, a bag house, system of cooling pipes, and crushing plant. Treatment will produce zinc oxide.

San Juan County

GENESEE (Red Mountain)—John F. Thompson states that he will build a 35-ton mill at portal of Joker tunnel, through which he proposes to work mine. At present he contemplates installation of a crusher, rolls, Hardinge mill and set of jigs.

Teller County

GOLDEN CYCLE MERGER is being negotiated with Paris men, to amalgamate Golden Cycle mine and mill, Vindicator, Granite, El Paso, and some smaller properties.

GRANITE (Victor)—It is planned to move Gold Coin plant of machinery up on Battle Mountain to Dillon shaft, making this shaft principal operating shaft of company.

DANTE (Cripple Creek)—It is said that controlling interest in this company has been sold to Eastern men. Gaylord lease is making regular shipments of ore of good grade, besides treating lower grades at Gaylord mill.

IDAHO

Cœur d'Alene District

SNOWSTORM (Mullan)—Deal for purchase of outstanding stock of Missoula Copper Co., 1,100,000 shares, which has been under negotiation for several weeks by C. E. Mallette, a Spokane mining broker, has been closed by unanimous vote of Missoula stockholders who were in pool. A stockholders' meeting has been called by Missoula company at Mullan for Apr. 18, formally to ratify contract, but there is no danger of sale being blocked, as more than 800,000 shares already are in pool. Purchase price is $600,000, or a little less than 75c. per share, $200,000 to be paid in one year and $50,000 each six months thereafter until final payment in four years. Contract stipulates that a royalty of from 5 to 30% based on net smelter returns from all shipments from Missoula mine by Snowstorm company are to be credited on payments. It is agreed further that development of Missoula is to begin immediately and that not less than $2000 per month is to be expended. As soon as enough ore is blocked out to warrant beginning shipments, which it is believed will be within 60 days, a surface tram line will be built from No. 2 tunnel of Snowstorm to Missoula and ore will be handled through Snowstorm main tunnel, mill feed to be sent to Snowstorm concentrator at Larson and high grade forwarded to smelters.

MICHIGAN

Iron

ZIMMERMAN (Iron River)—Orders have again been received to reopen this property and 100 men are now employed. Mine was closed last year but word came about a month ago to get ready to start.

NEWPORT (Ironwood)—A new hoisting record was made last week, when 3735 tons of ore were brought to surface through one shaft in one 8-hr. shift. Best previous record was far below this. Best record for two consecutive shifts stands at 6200 tons.

CLEVELAND-CLIFFS IRON CO. (Ishpeming)—Company has just completed a 900-ft. suspension foot-bridge across east end of storage reservoir on Carp River to storage dam. Bridge is for use of workmen who have to go to dam and means a saving of two miles. Strips of pine, 1½ in. in diameter, were fastened to cables, leaving space of 3 in. between each strip so that snow could pass through and relieve weight. A cable on each side acts as a guard rail. Persons unaccustomed to traveling on such bridges are warned to keep off.

MINNESOTA

Cuyuna Range

BARROWS (Barrows)—This south range pioneer continues to stockpile regularly. About 20,000 tons are ready for loading.

PENNINGTON (Crosby)—Two shovels working to prepare pit for early operation. An engine and boiler house are being constructed.

WILCOX (Brainerd)—Shaft now down about 18 ft. with a large force at work. Compressor is electrically driven, of 1000-cu.ft. capacity. Ingersoll-Rand drills, of hammer type are used.

Mesabi Range

BUFFALO-SUSQUEHANNA (Hibbing)—This open pit, within city limits of Hibbing, has contracted to ship 1,000,000 tons of ore during 1914 season. Operations have started.

BRAY (Keewatin)—Mine was to resume operations Apr. 1. It has not stockpiled during winter, being shut down since last autumn. Shipments will be made from underground workings and open pit, where one shovel will be employed.

Vermilion Range

SIBLEY (Ely)—Construction has started on a new dry house to be entirely of concrete and steel with accommodations for 300 men in addition to office room. Located only a short distance from new shaft now being raised from tenth level of Sibley mine. Two shifts are employed daily in shaft-raising operation. Hoisting machinery is being installed in mine to raise steel work going into new shaft. Operations in other parts of mine are not being interfered with by shaft work.

NORTH AMERICAN (Tower Junction)—It is now reported that a body of graphite has been encountered. This property, which has a modern concrete-lined shaft, steel headframe and modern surface machinery, as well as a complete set of buildings, was originally organized as an iron mining company. After several years of operation, iron ore has not been encountered. Later, President T. J. Walsh, announced that rock encountered was gold bearing, and that a small mill would be erected. Now comes graphite announcement. Company is a stock company, with shares well scattered throughout Minnesota iron districts. [Fish in the sump?—Editor].

MISSOURI-KANSAS-OKLAHOMA

Joplin District

MUIR TRACT (Galena, Kan.)—George Horning has made profitable strike on this land. Two drill holes on 40-acre lease showed ore from 90 to 110 feet.

NEW CENTURY (Galena, Kan.)—Representatives of Durston Mining Co. negotiating for lease of this property, with view to resuming operations. Concentrator is of 300-tons capacity and lease embraces 100 acres. Property has been idle some time but once produced well.

BEAR CAT (Sarcoxie, Mo.)—This mine has passed to new management, William Staley, of Webb City, Mo., being latest operator to "try his luck" with it. Staley is said to be backed in venture by St. Louis, Kansas City, Joplin and Pittsburg, Kan., men. Mine is on J. W. Boyd land.

GEYSINGER LAND (Galena, Kan.)—This land now has many good prospects, shafts being sunk and drilling in progress. Savage, Endicott & Co. are producing both lead and zinc ore from 60-ft. level. Rohrbaugh Bros. & Moore are sinking shaft to orebody encountered by drill. Several good drill strikes have been made by other operators.

MONTANA

Beaverhead County

BOSTON & MONTANA DEVELOPMENT CO. (Butte)—Freeman I. Davidson, of Boston, recently returned from London. He reports having closed a deal with London men for carrying into effect plans for developing mining property in Elkhorn district at head of Wise River and building Butte, Wisdom & Pacific Ry. connecting district with Butte.

SAGINAW (Jackson)—This is an old property between Jackson and Brenner, on Oregon Short Line, from which another promising strike of ore is reported. Mine is one of a group owned by George North and W. A. Kidney. Shipment of ore was recently made to Garfield smelter in Utah of ore that ran 10½% copper. There is on dump 1000 tons of ore running perhaps 8% copper which is to be treated in a leaching plant that owners contemplate erecting in near future. The high-grade copper ore is being sacked and will be shipped direct to smelter.

Cascade County

POWER CITY OIL & NATURAL GAS CO. (Great Falls)—Driiiing operations for oil and gas have been started on townsite of company near Great Falls. Drills of company are capable of going to a depth of 4000 ft. if necessary, but it is expected that oil and gas will be encountered without drilling that deep.

Deer Lodge County

TRIUNE (Georgetown)—Strike of a 30-ft. vein in tunnel on 70-ft. level was reported by Murdock & Van Dyke, who have a lease and bond for deed on this claim. Ore is said to assay as high as $25 in gold. Vein was encountered 180 ft. from Main shaft. Operators contemplate sinking shaft to follow vein. Triune claim is west of Southern Cross mine, a property of Anaconda.

WASHOE SMELTING WORKS (Anaconda)—Work of excavating and grading for new 2000-ton leaching plant, authorized recently by directors, was started Mar. 27. Plant will be just east of present concentrator. It is divided into five departments, consisting of dewatering, roasting, acid preparation, leaching and precipitation departments. New plant is essentially an enlargement of the design developed in 80-ton experimental plant. Plant is being installed to treat present tailings from concentrator, but may eventually be enlarged to retreat old tailings now on dumps. Plant will cost about $1,250,000. Slime plant, consisting of Dorr thickeners and group of 20-deck round tables, started full operation Mar. 13 and is proving a great success. Experiments are being made to determine merits of coal-dust firing with a view of introducing it in reverberatory furnaces. Coal is to be ground to dust and blown into furnaces, making a flame like oil or gas. This is claimed to result in generation of greater heat, in saving of coal and in a reduction of clinker.

Granite County

ROYAL BASIN MINING CO. (Maxville)—Development work during last few months has been so promising that a concentrator is being built for treating copper ore and it has been decided to electrify the plant. Surveyors are now at work on right-of-way for a power line from Philipsburg to mines, six miles north.

Musselshell County

REPUBLIC COAL CO. (Roundup)—By a vote of 32 to 24, U. S. Senate restored to calendar bill introduced by Senators Myers and Walsh to authorize Secretary of the Interior to sell or lease to company 20,000 acres of coal land in order to enable this company to furnish coal to Chicago, Milwaukee & St. Paul R.R. Action on bill itself was delayed to debate another amendment providing that half of any royalty should go to Montana for public-school purposes.

Silver Bow County

ANACONDA COPPER MINING CO. (Butte)—On night of Mar. 25, dry house at Anaconda mine, after 20 years' continuous use was burnt to ground. Luckily, fire started after 5 p.m., after day shift had left and before night shift had reported for duty. Thus none of the men lost their day clothes. It was a two-story brick building. Damage is estimated at $5000. It is believed that a carelessly thrown cigarette or cigar started fire. Pending erection of a new dry house, Anaconda shifts will be accommodated in dry house of adjoining Never Sweat mine.

NEVADA

Clark County

MOBILE (Goodsprings)—Property has been honded to Los Angeles men and a force is engaged in development. Orders have been placed for material for an aërial tramway, 2000 ft. long, which will be erected at once. Ore is zinc-carbonate, carrying some lead and silver.

POTOSI (Goodsprings)—Since recent purchase of this property by Empire Zinc Co., 30 men have been engaged in development, but no ore has been shipped. A motor-truck road has been built from mine, 20 miles to Arden, on San Pedro R.R. This road suffered considerable damage from recent storms, but has since been repaired. Orders have been placed for three Saurer motor trucks for hauling ore, and it is expected that shipments will commence in near future. It is reported that a large tonnage of zinc-carbonate ore has been developed in lower levels.

Elko County

ELKO MINING CO. (Jarbidge)—Shaft has been sunk to 400 ft. Force of 15 men is being employed and 5-stamp mill has been operated all winter. Property is controlled by Potter Palmer estate, of Chicago.

TUSCARORA MINING CO. (Tuscarora)—Suit has been filed in district court for ownership of five mining claims, Phoenix, Golden Treasurer, Bryan, New Homesdale, New Era and Golden Morning, also Grand Prize mill and all machinery and water ditch of Phoenix mine. Complaint alleges that defendants' title to property was obtained by decree of foreclosure issued out of district court.

Esmeralda County

KLONDIKE MINING CO. (Klondike)—A 10-stamp mill and cyanide plant will be built. Mill is expected to have capacity of 60 tons daily. Mine is developed by 250-ft. shaft and 4000 ft. of drifts and winzes. It is stated that 30,000 tons of $16 ore are blocked out. When mill is completed, two-compartment shaft will be sunk and other development work done.

GOLDFIELD MERGER MINES CO. (Goldfield)—By sale of Velvet claim $85,000, it is stated, will be available for further development work. Company has nine claims remaining, and prospecting will commence at once. Chief work to date has been sinking of 1750-ft. shaft and driving of crosscut on 1350-ft. level to connect with Grizzly Bear workings of Goldfield Consolidated company, and a crosscut on 1750-ft. level to Atlanta ground.

Humboldt County

ROCK (Rochester)—This lease in northern part of district has opened 2-ft. shoot of shipping-grade ore and 5 ft. of ore assaying $15.

SEVEN TROUGHS COALITION (Seven Troughs)—Development work is being continued in high-grade oreshoot discovered below 1000-ft. level. New stope will soon be started south of winze and stoping drills will be installed.

BLACK HOLE (Dun Glen)—Mine and mill will be operated by lessees. Black Hole tunnel will be advanced to further prospect ground. Ore assaying $10 can be mined and milled at a profit.

Lander County

GRUE LEASE (Battle Mountain)—Dry washing on this placer ground, which is above water, is being done with satisfactory results.

BANNOCK (Battle Mountain)—Pay streak on bed rock in this placer mine is being worked through raise driven from old lode-prospecting tunnel.

CHRISTIANSEN & DAHL (Battle Mountain)—This placer mine in Copper Cañon is producing $600 to $700 per day, it is stated. Force of 25 miners is working and will be increased in near future.

AUSTIN-DAKOTA (Austin)—Night shift has been added to mine force and work of sinking new incline shaft is being hastened. Drifting will commence at once on 165-ft. level. Assays from foot-wall shoot, opened in incline, gave good values in gold and silver. It is expected that shipping will commence in near future.

KIMBERLY CONSOLIDATED MINING CO. (Hilltop)—Operations, which were temporarily suspended on account of accident to compressor plant, have been resumed. Contract for sinking new shaft 500 ft. has been let, and shaft is now 21 ft. deep. Suitable equipment will be installed. Hoist has arrived, and engine room and carpenter shop are being built. Extensive development by crosscutting and raising is also being done. It is stated that mill will be increased to 40 stamps.

Lincoln County

AMALGAMATED PIOCHE (Pioche)—Sump below 1500-ft. level of No. 1 shaft is finished. Crosscuts will be driven to Yuba dike and Black Ledge vein. Pumps recently installed were tested and found to be satisfactory. At present pumping is not necessary, but mine is expected to make more water when crosscutting is started.

Mineral County

FREIGHT ROUTE FROM HUDSON TO AURORA was reopened recently. This route was closed by severe storms about three months ago.

PINE GROVE MINES CO. (Pine Grove)—Concentrate shipment of 100 tons was made recently. This is the first shipment since shutdown this winter on account of power troubles.

YERINGTON MOUNTAIN COPPER CO. (Shurz)—Bad roads continue to interfere with ore haulage. Contract has been let for haulage, to start Apr. 1. Car every second day will be shipped at start, and amount may be increased during summer

NEVADA-HAWTHORNE COPPER MINING CO. (Luning)—Operations on this property near Acme will be resumed in near future. Modern equipment will be installed and development work on large scale will be done. There are strong outcrops, and high-grade copper ore has been shipped from surface cuts in past.

SILVER STATE MINING & LEASING CO. (Yerington)—At this property in Lappan Cañon, 40 miles south of Yerington, a new crosscut tunnel is being driven to cut vein exposed on surface. Drifting on vein will then be done. Tunnel No. 2, 700 ft. above this crosscut tunnel, has opened 18-in. shoot of high-grade ore. Remainder of vein is low-grade milling ore. Two-stamp mill has been erected and will be put into commission in the near future. Water-pipe line, 1600 ft. long, from Lappan Creek, is being built.

Nye County

HIGH-GRADE GOLD-SILVER ORE IN NORTH TONOPAH, it is stated, was discovered recently. Shoot assays $40 to $60. Rush has been made from Tonopah, four miles south, and many claims have been staked.

ROBBERS MILL (Manhattan)—This 10-stamp mill, at foot of Litigation Hill, is being overhauled. Ore from Earle lease will be treated.

WEST END CONSOLIDATED (Tonopah)—Shaft has been retimbered and mill repaired. Sinking from 800-ft. level will be resumed at once, and 30-stamp mill will be operated to full capacity.

White Pine County

RAILROAD FROM ELY TO PIOCHE, it is reported, will be built by San Pedro, Los Angeles & Salt Lake R.R.

CONSOLIDATED COPPER MINES CO. (Ely)—It is reported that experimental milling plant will be built on hill opposite East Ely. Application to take water from Murry Creek in Central Ely to this point has been made.

NEW MEXICO

Eddy County

ARTESIA COPPER CO. (Artesia)—Owners report that development work will be commenced soon.

Grant County

ZUNI (Sawyer)—It is reported that a leaching plant of 100 tons daily capacity to treat copper-carbonate ore, is to be constructed. Results of experimental plant have been satisfactory.

PHELPS-DODGE (Fierro)—Tunneling has been commenced on southeast side of Hanover Mountain. Doctor James and Walter Douglas inspected operations at Emma mine week before last.

Socorro County

CALUMET COMMERCIAL CO. (Phillipsburg)—Air compressor and drills have been purchased and work continued below 500-ft. level. Idle 10-stamp mill and cyanide plant will be remodeled and operated.

Taos County

PLACER CREEK & BLACK MOUNTAIN MINING CO. (Red River)—A small crew of men has been put to work in developing property.

SOUTH DAKOTA

Lawrence County

MOTOR CYCLES FOR FIRE FIGHTERS on Black Hills national forest will be a feature of the patrol Government is exercising over timber lands. Two late model, high-power, Harley-Davidson machines have been ordered, and when equipped with a few light tools will, it is believed, be of material aid in subduing fires.

ORO HONDO (Lead)—Water has been removed from workings and work of sinking will immediately commence.

MONARCH (Two Bit)—Lease held by Nickoli Bros. expired Mar. 20 and their final shipment of ore has been made to Denver smelter. In last lot were 20 tons, assaying $100. It is stated owners will erect small treatment plant for a considerable tonnage of medium-grade ore on dumps.

TROJAN (Trojan)—While known principally as operator of a successful cyanide plant, handling 200 tons daily of ore worth $6 per ton, this company occasionally makes shipments to Denver smelter of rich selected ore. Last lot of this character consisted of 20 tons and the gross value of the lot was in excess of $10,000—or better than $500 per ton.

NEW RELIANCE (Trojan)—According to report by manager, operations have been more than ordinarily successful since Aug. 1. Subsequent to that date mill heads have averaged $6.23 per ton, mill handling 70 tons daily, which is 60% of the mill's capacity. Profits have been earned. Diamond drilling is under way, and will be continued to basal cambrian quartzite, which is believed to be about 500 ft. deep.

HOMESTAKE (Lead)—William Butler, who has contract for excavating and grading for some of the Homestake improvements, has put a crew at work on site of boiler house. This plant will contain six boilers of 650 hp. each, connected in pairs. Steam generated will be used to operate an auxiliary electric plant, a 3000-ft. hoist and big compressor at Old Abe, or B. & M., shaft, and for minor work. These improvements, completed, are expected to cost about $350,000.

TITANIC (Carbonate)—Owing to condition of wagon road between Trojan and Carbonate it has been next to impossible to keep a supply of coal on hand to maintain development at full capacity, but in face of difficulties, shaft has been completed to 300 ft. and timbering is now being completed, and a drift driven to connect with old Iron Hill workings. On both 100 and 150 levels ore has been found; on upper level it shows 30 to 40 oz. of silver and a few dollars in gold, per ton; ore on 150 level carries $3 to $7 in gold and a few ounces of silver. This has been crosscut for a considerable distance. On 300-ft. level further work will include drifting, crosscutting and diamond drilling.

Pennington County

DAKOTA CONTINENTAL COPPER (Hill City)—Sinking has been discontinued with shaft at depth of 850 ft., and station being cut at 825 ft., leaving 25-ft. sump. Lateral work to open ore will be instituted from this level.

UTAH

Beaver County

LEONORA (Milford)—Ore carrying silver and lead has recently been opened.

MONITOR (Milford)—Twenty tons of ore were recently mined from a winze below tunnel level. Vein has been opened 15 ft. on its strike, and is up to 6 ft. between walls. It carries lead, silver and gold. A boiler and hoist have been installed. Property is in Star district, south of the Moscow.

MOSCOW (Milford)—In February 10 cars of lead-silver ore were shipped. Ore was found in new working shaft at 570 ft. A station is to be cut on 600. Recent strike of lead-carbonate ore on 800 level of old workings is improving, and has been followed some distance. Part of ore runs exceptionally well in lead and silver.

UTAH MINING, MILLING & TRANSPORTATION (Milford)—Shipments are to be resumed from this company's Lady Bryan property. Development is being done on 300 level, and ore carrying silver and lead with an excess of iron has been opened in east drift. Copper ore has also been found. Property adjoins Moscow.

Salt Lake County

BINGHAM MINES (Lark)—Lead ore has been opened on 800-level of Yosemite mine. Yosemite was drained to 1100, when Mascotte tunnel was driven, and operations were resumed last year. Development is in progress on 500, 800 and 1100-ft. levels.

SOUTH HECLA (Alta)—There are 200 tons of ore in bins and more broken in mine, awaiting shipment. Hauling has been delayed on account of soft roads. New haulage drift 250 ft. above Dwyer tunnel has been driven 600 ft. This will permit better handling of ore.

WASATCH MINES (Alta)—Good progress is being made by lessees at Columbus Consolidated, but ore has to be piled awaiting shipment. Flagstaff mine owned by this company is to be put in shape for leasing; there are about three miles of workings. There has been an unusual absence of snowslides during present season in Cottonwoods.

MONTANA-BINGHAM (Bingham)—Tunnel has passed through a 2½-ft. vein of ore, which assays well in copper, with some silver and gold. Face at present is in mineralized quartz, being over 2800 ft. from portal. Rock showing mineralization was opened for 136 ft. before reaching vein. Some additional ground has been acquired from Tiewaukee.

SELLS MINING (Alta)—Company has been formed to work claims in Little Cottonwood. Ground is on south side of cañon, west of South Hecla. Air and electric power will be secured from Wasatch Mines Co., and arrangements have been made to reach property through South Hecla workings, which are within 35 ft. of new company's lines. Capitalization is $150,000, divided into 600,000 shares, par value 25c. Tony Jacobson, A. O. Jacobson, V. S. Snow, C. F. Parr and R. S. Lewis are interested.

OHIO COPPER (Bingham)—Three sets of rolls 24x60-in., similar to those in use at Magna and Arthur mills of Utah Copper Co., have been ordered, and will be installed as soon as possible. These, together with new conveyor equipment, it is expected will raise mill capacity from 2300 to 3000 tons a day. Hitherto coarse-crushing section working on hard rock has been unable to keep tables up to capacity. Excavation for new concrete foundation is finished, and new installation will be completed about middle of July. After crushing facilities have been improved, it is hoped to make some improvements in flow sheet; and better recoveries in concentrating department.

WISCONSIN

Platteville District

WILKINSON—Mine continues a large shipper of pyrites, sending from 200 to 400 tons per week to the Chicago market.

NEW JERSEY ZINC CO.—Fox mine has been equipped with miners' cottages; it is shipping regularly to Mineral Point plant.

CANADA

Ontario

POWER FOR KIRKLAND LAKE MINES should be available in May.

DOBIE (Munro Tp.)—This property is under option to Erlich & Co.'s representatives.

NIPISSING (Cobalt)—Hydraulic prospecting will start this year on ground near Peterson Lake.

PETERSON LAKE (Cobalt)—This company will shortly ship its first car of high-grade which runs 2500 oz. per ton.

VIPOND (South Porcupine)—Plant has been rented to North Thompson owners in order to permit of underground development.

BURNSIDE (South Porcupine)—Balance of purchase price, amounting to $200,000, has been paid by Kirkland Lake Proprietary.

KEELEY (Cobalt)—This mine has been reopened under control of Huronian Belt Mining Co., a subsidiary of Erlich & Co., of London.

McKINLEY-DARRAGH (Cobalt)—At annual meeting, president forecasted high production costs. Proposed deal for Jupiter was ratified by shareholders.

GENERAL DEVELOPMENT CO. (Timmins)—This company, which now owns the Hollinger Reserve mine, has rented original McIntyre mill in order to test its ore.

PORPHYRY HILL (South Porcupine)—C. L. Sherrill, of Buffalo, has made an offer of $40,000 for an 80% interest in this property, which formerly belonged to the Preston East Dome. Sherrill has also made offers of $25,000 each for an 80% interest in Fog and Little Pet properties adjoining Porphyry Hill.

CANADIAN COPPER CO. (Copper Cliff)—Recent developments at Creighton mine have shown a much larger tonnage than was anticipated by management. Ore on this property is of considerably higher grade than at Froude or No. 3, where a tonnage stated to be 40,000,000 tons has been developed. On account of higher grade of ore in Creighton and large tonnage being shown up by development, company has decided to do only a limited amount of work at No. 3, as Creighton mine will provide necessary ore for a number of years to come. Only sufficient work at No. 3 mine will be carried on to permit of a limited amount of development and a comparatively small tonnage necessary to flux Creighton ore.

CHOSEN

ORIENTAL CONSOLIDATED—February production $149,084 from 2954 tons of ore. Candlestick mill was expected to run all through March. When Koreans learned that company intended to lease this mine to Koreans, they flocked to work at Candlestick in great numbers, in order to be on ground at moment mine would be turned over to lessees. For this reason there was a full crew at Candlestick mine for first time in several years, and company is able to sort the ore properly. The Taracol shaft was retimbered from surface to 10 ft. below No. 1 level during February, and work is being continued as rapidly as possible.

The Market Report

METAL MARKETS

NEW YORK—April 8

The metal markets continue to show little animation and buyers are not taking an active interest. Movements in price have been largely of a speculative character.

Copper, Tin, Lead and Zinc

Copper—The improving tone of the market noted in our last report continued, and by April 3 it was on substantially the basis of 14⅝c., delivered, usual terms, and a fair amount of business was done. One of the producers then raised its asking price to 14¾c., delivered, usual terms, and on April 4, that price was actually realized for small business, but it did not become firmly established. It was practically abandoned on April 6 when the market relapsed into dullness and 14⅝c., delivered, usual terms, was named generally as the price asked, some transactions being made at that figure and some at concessions therefrom, there being some pressure to sell. On the following days concessions in order to effect business became more the order of things, the buying demand having become quite slack. However, the domestic consumption appears to be improving and the European consumption continues good. The average of quotations for electrolytic copper during the week is 14.442 cents.

The London market for standard copper has fluctuated within narrow limits, spot around £65 15s. and three months £66 2s. 6d. Spot closes at £65 16s. 3d. and three months £66 3s. 9d. per ton.

The market for Lake copper is quoted as a nominal affair. Little or nothing is disclosed respecting the position of the principal producer. Other producers report no business at all.

Base price of copper sheets is now 19¾c. per lb. for hot rolled and 20¾c. for cold rolled. The usual extras are charged and higher prices for small quantities. Copper wire is 15 @15½c. per lb., carload lots at mill.

Copper exports from New York for the week were 7194 long tons. Our special correspondent reports exports from Baltimore for the week at 2003 tons.

Visible Stocks of Copper on Mar. 31 are reported as follows: Great Britain, 9950; France, 1790; Rotterdam, 3200; Hamburg, 3950; Bremen, 1090; other European ports, 750; total, 20,730 long tons, or 46,435,200 lb. This is a decrease of 470 tons from the Mar. 16 report. In addition to the stocks above given, 2350 tons are reported afloat from Chile and 3800 from Australia, making a total of 26,880 tons in all.

Tin—The market has developed further weakness. The bears in the London market were very aggressive, and under their selling prices broke easily. Consumers in this market took advantage of the lower level reached to purchase freely. The market closes steady at £167 7s. 6d. for spot and £169 5s. for three months, and about 36¾c. for April tin here.

Straits shipments of tin in March were 4500 tons. For the three months ended March 31 the total shipments were 15,429 tons in 1913, and 15,354 in 1914; a decrease of 75 tons.

Tin output of the Federated Malay States in February was 3270 long tons. For the two months ended Feb. 28 the production was 7944 tons in 1913, and 7847 in 1914; a decrease of 97 tons.

Visible Stocks of Tin on Mar. 31 are reported as follows, including tin afloat: London, 8727; Holland, 2288; United States, excluding Pacific ports, 5974; total, 16,989 long tons, which is a decrease of 319 tons from Feb. 28. Of the London stocks 2483 tons were standard tin and 3604 tons Straits tin.

Lead—The principal interest is reported as feeding out lead right along at the last prices. Other producers have made sales to their regular customers on about the same basis, but among them a firmer tone has been exhibited, with a disinclination to supply anybody but regular customers on the present level of prices.

Exports from Baltimore for the week included 896,559 lb. lead to Liverpool.

Spanish lead in London is quoted £18 2s. 6d.; English lead 17s. 6d. higher.

Spelter—It is difficult to say just what is the real basis of spelter and we call the market nominal during the last week. Producers have offered it liberally at 5.10c., St. Louis, and a shade under right through the week. They have not found buyers for any quantities worth mentioning. Such business as has been done has been more of the retail order than anything else. Leading consumers have intimated willingness to buy at 5c., but none of the producers thinks of going so low as that.

The London market for good ordinaries is quoted £21 10s.; specials 12s. 6d. higher.

Base price of zinc sheets is now $7 per 100 lb. f.o.b. Peru, Ill., less 8% discount, with the usual extras.

DAILY PRICES OF METALS

NEW YORK

Apr.	Sterling Exchange	Silver	Copper		Tin	Lead		Zinc	
			Lake, Cts. per lb.	Electrolytic, Cts. per lb.	Cts. per lb.	New York, Cts. per lb	St. Louis, Cts. per lb.	New York, Cts. per lb.	St. Louis, Cts. per lb.
			*14½	14.35			3.67½	5.22½	*5.07½
2	4.8635	58⅜	@14⅝	@14.45	37½	3.80	@3.70	@5.25	@5.10
			*14½	14.40			3.65	5.22½	*5.07½
3	4.8645	58½	@14⅝	@14.50	37¼	3.80	@3.70	@5.25	@5.10
			*14½	14.50			3.67½	5.22½	*5.07½
4	4.8655	58⅜	@14⅝	@14.60	37¼	3.80	@3.70	@5.25	@5.10
			*14½	14.40			3.67½	5.22½	*5.07½
6	4.8640	58⅜	@14⅝	@14.50	37⅛	3.80	@3.70	@5.25	@5.10
			*14½	14.35			3.67½	5.22½	*5.07½
7	4.8640	58⅜	@14⅝	@14.45	36¾	3.80	@3.70	@5.25	@5.10
			*14½	14.35			3.67½	5.22½	*5.07½
8	4.8640	58½	@14⅝	@14.45	36¾	3.80	@3.70	@5.25	@5.10

*Nominal.

The quotations herein given are our appraisal of the markets for copper, lead spelter and tin based on wholesale contracts; and represent, to the best of our judgment, the prevailing values of the metals specified as indicated by sales by producers and agencies, reduced to basis of New York, cash, except where St. Louis is given as the basing point. St. Louis and New York are normally quoted 0.15c. apart. The quotations for electrolytic copper are for cakes, ingots and wirebars. The price of electrolytic cathodes is usually 0.05 to 0.10c. below that of electrolytic; of casting copper 0.15 to 0.25c. below. The quotations for lead represent wholesale transactions in the open market for good ordinary brands; the specially refined corroding lead commands a premium. The quotations on spelter are for ordinary Western brands; special brands command a premium. Silver quotations are in cents per troy ounce of fine silver.

Some current freight rates on metals per 100 lb., are: St. Louis-New York, 15½c.; St. Louis-Chicago,6c.; St. Louis-Pittsburgh, 12½c.; New York-Bremen or Rotterdam, 15c.; New York-Havre, 16@17½c.; New York-London, 16c.; New York-Hamburg, 18c.; New York-Trieste,22 c.

LONDON

Apr.	Silver	Copper				Tin		Lead		Zinc	
		Spot									
		£ per Ton	Cts. per Lb.	3 Mos.	Best Sel'td	Spot	3 Mos.	£ per Ton	Cts. per Lb.	£ per Ton	Cts. per Lb.
2	26 11/16	65⅞	14.53	66⅛	70	171¼	172¼	18½	3.94	21⅛	4.70
3	27	65⅞	14.53	66⅛	70	169½	171½	18¼	3.97	21⅛	4.69
4	26 11/16	....	....	....	....	....	....	....	....	....	....
6	26 11/16	65¾	14.50	66⅛	70	169¼	171	18⅛	3.94	21⅛	4.69
7	27	65¾	14.50	66⅛	70	167¼	169	18⅛	3.94	21⅛	4.69
8	26 11/16	65 13/16	14.52	66 3/16	70	167⅜	169¼	18⅛	3.94	21⅛	4.69

The above table gives the closing quotations on London Metal Exchange. All prices are in pounds sterling per ton of 2240 lb., except silver which is in pence per troy ounce of sterling silver, 0.925 fine. Copper quotations are for standard copper, spot and three months, and for best selected, price for the latte being subject to 3 per cent. discount. For convenience in comparison of London prices, in pounds sterling per 2240 lb., with American prices in cents per pound the following approximate ratios are given: £10 = 2.17½c.; £15 = 3.26c = £25 = 5.44c.; £70 = 15.22c. Variations, £1 = 0.21¾c.

Other Metals

Aluminum—Business has been quiet and sales few. Little business is going except on contract. Prices are weaker and 17¾@18¼c. per lb. may be quoted for No. 1 ingots, New York delivery.

Antimony—Business is quiet, but there is a fair jobbing demand. Prices are unchanged, at 7.25@7.50c. per lb. for Cookson's; 7@7.15c. for Hallett's; 5.90@6.15c. for Chinese, Hungarian and other outside brands.

Quicksilver—Business is more active with sales good. New York quotations are $38 per flask of 75 lb. for large lots, and 54c. per lb. for jobbing orders. San Francisco, $38 for domestic orders and special terms for export. London price is £7 per flask, with £6 7s. 6d. asked by second hands.

Nickel—Quotations for ordinary forms—shot, blocks, or plaquettes—are 40@45c. per lb., according to size of order and quality. Electrolytic nickel is 5c. per lb. higher.

Gold, Silver and Platinum

Gold—The demand for gold in the open market in London, while still good, was not sufficiently pressing to cause any premium to be paid over the usual price of 77s. 9d. per oz. for bars. Some gold is expected to go to Argentina soon.

Gold in the United States, Apr. 1, is estimated by the Treasury Department as follows: Held in Treasury against gold certificates outstanding, $1,142,471,969; in Treasury current balances, $179,065,124; in banks and circulation, $605,642,125; total, $1,927,179,218. This is an increase of $6,910,470 during March.

Imports of gold into Russia during the year 1913 were £1,650,000; exports, £1,047,000; net imports, £603,000. Of the imports £1,628,000 were in bars, £11,000 in foreign coin and £11,000 in Russian coin.

Iridium—The price remains about the same as for several weeks, dealers asking $75@78 per oz., New York.

Platinum—The market is inclined to be quiet but is steady and no change is noted. Dealers ask $43@44 per oz. for refined platinum and $46@49 for hard metal. There is talk of a speculative advance abroad but none has yet been made.

Our Russian correspondent writes under date of Mar. 26 that there has been no large business, but the demand for small lots continues good and sellers are inclined to ask higher prices. Quotations, however, are unchanged at 9.65 rubles per zolotnik at Ekaterinburg, and 37,200 rubles per pood at St. Petersburg for crude metal, 83% platinum. These prices are equivalent to $36.28 and $36.46 per oz., respectively.

Silver—The information that the London syndicate has closed out its bullion holdings has had the tendency of giving a little more tone to the silver market. Buyers must now depend on the open market, and it remains to be seen if supplies will be sufficient to satisfy the demand without advancing the market. Opinion seems to be a slightly higher price may be realized.

Shipments of silver from London to the East, Jan. 1, to Mar. 26, as reported by Messrs. Pixley & Abell:

	1913	1914	Changes
India	£2,084,000	£1,637,000	D. £447,000
China	95,000	40,000	D. 55,000
Total	£2,179,000	£1,677,000	D. £502,000

Coined silver in the United States, Apr. 1, is estimated by the Treasury Department as follows: Dollars, $565,772,263; subsidiary coins, $180,060,441; total, $745,832,704. Of the dollars $469,749,000 are held in the Treasury against silver certificates outstanding.

Imports of silver into Russia during the year 1913 were valued at £708,000; exports, £57,000; leaving £657,000 net imports.

Zinc and Lead Ore Markets

JOPLIN, MO.—Apr. 4

Blende sold as high as $43, the assay base ranging from $38 to $40 and the metal base from $37 to $38 per ton of 60% zinc. Calamine sold at $20@23 per ton of 40% zinc. The average price of all grades of zinc is $37.18 per ton. Lead declined another $3 per ton, some settlements being made on prices of two weeks ago, a few on last week's quotations and others on current quotations. The base range is $45 for this week's buying, with settlements made up to $50 per ton of 80% metal content. The average of all grades is $47.32 per ton. One settlement was made as high as $53.50 per ton.

Freer offers of cars enabled buyers to clean up on last week's shortage of shipment of zinc ore. Purchases were light this week; little of the ore purchased is unreported tonight.

SHIPMENTS WEEK ENDED APR. 4

	Blende	Calamine	Lead	Value
Total this week..	10,487,920	760,000	1,632,990	$247,775
Total 14 weeks...	143,845,960	8,797,790	25,039,630	$3,600,820

Blende value, the week, $200,570; 14 weeks, $2,875,930.
Calamine value, the week, $8570; 14 weeks, $100,345.
Lead value, the week, $38,635; 14 weeks, $624,545.

PLATTEVILLE, WIS.—Apr. 4

The base price paid this week for 60% zinc ore was $39@40 per ton; 80% lead ore sold for $50 per ton. All shipments were light, due to the bad roads for hauling.

SHIPMENTS WEEK ENDED APR. 4

	Zinc ore, lb.	Lead ore, lb.	Sulphur ore, lb.
Week	2,077,150	64,090	304,920
Year	39,499,000	1,245,190	13,211,730

Shipped during week to separating plants, 2,588,180 lb. zinc ore.

IRON TRADE REVIEW

NEW YORK—Apr. 8

New business remains scarce and the conditions of the market have not materially changed. Buyers do not seem in any hurry, though specifications come in well.

Structural material has quieted down as compared with March, and fewer contracts are reported. Plates and bars are quiet, with no increased demand in sight.

Sentiment in the market, which was inclined to be hopeful a little while ago, has taken a turn, and a long period of quiet is now expected, for what reason is not altogether clear.

Pig iron is quiet in the West. In the East it has been more active, but prices are rather irregular.

PITTSBURGH—Apr. 7

Steel-mill operations continue to decrease, but slowly, and as a result of the decrease in buying which occurred a few weeks ago. In the past week there has been no further decrease.

Steel prices continue to weaken in spots. Sheets have become quotable $1 a ton lower, at 1.90c. Pittsburgh, for black and 2.90c. for galvanized, and plates and bars are more easily done at 1.15c. Billets are not over $21 and sheet bars not over $22, representing a decline of $1 a ton from the former nominal market.

Sentiment in Pittsburgh steel circles has begun to exhibit a slight improvement. The change is far from general, and is based upon judgment and analysis rather than upon any definite favorable developments, for of really favorable developments there have been none. Orders continue light, though no lighter than they were a fortnight ago, but the continuance of light buying results from week to week in somewhat lighter mill operations and in weakening in prices.

It is evident that there can be no serious break in steel prices, since the general level is already low, within about $2 a ton of the low point reached at the close of 1911, and that level is regarded as impossible now since costs have increased through the general wage advance of February, 1913. While the question of wage reductions is occasionally discussed there is no real prospect that there will be any reductions of moment, unless the present unsatisfactory conditions should be continued for months.

The steel trade has strong hopes that an early and favorable decision in the railroad-rate case will bring decided improvement, not so much through its bringing the railroads into the market as large buyers as through its encouraging other buyers to take hold on the basis that there would be no room for further unfavorable developments.

At many mills in the Pittsburgh district production has been decreasing and the district as a whole is not operating at over about 75% of capacity at the outside. The average for the whole country is estimated at not over 65%. If there is no improvement over the present rate of buying production will have to be decreased further.

Pig Iron—The market continues absolutely stagnant, there being no new buying except as to occasional small lots. On the other hand there is still more disposition for consumers to curtail shipments on old contracts, such shipments being now at perhaps 20 to 30% below the contract requirements on an average. Prices are not being seriously

tested and remain quotable as follows: Bessemer, $14; basic, $13; malleable, $13@13.25; No. 2 foundry, $13.25; forge, $12.75, at Valley furnaces, 90c. higher delivered Pittsburgh. No furnaces appear to be contemplating blowing in, while there are rumors that a few may blow out.

Ferromanganese—The market is quiet, quotations remaining at $38@39, Baltimore, for prompt or contract.

Steel—It has become evident that billets can be had at $21 and sheet bars at $22, and it is possible that even these prices could be shaded. Nominally the market had been $22 for billets and $23 for sheet bars, the prices announced two months ago as applying to second quarter. There is practically no demand. Rods are quiet at $26, Pittsburgh.

IRON ORE

All indications point to a late opening of navigation this spring. Vessels will hardly leave Lake Superior ports before Apr. 15, and it is probable that no cargoes may arrive before the end of the month.

Iron-ore shipments from Lake Erie docks to furnaces in March were 820,741 tons. Dock stocks on Apr. 1 are reported at 6,925,678 tons. No new ore is expected to arrive before May.

FOREIGN NOTES

German Foreign Trade in Iron and Steel in January was as follows, in metric tons:

	Exports	Imports	Excess	
Iron and steel	499,627	41,302	Exp.	458,325
Machinery	41,375	8,751	Exp.	32,624
Total	541,002	50,053	Exp.	490,949
Total, 1913	538,909	58,926	Exp.	479,983

There was very little change in exports this year, but a considerable decrease in the imports.

COKE

Production of coke in the Connellsville region for the week is reported by the "Courier" at 360,918 tons; shipments, 347,490 tons. Output of the Greensburg and Upper Connellsville districts was 44,831 tons.

Connellsville Coke—The market has lost ground in that a few consumers who were uncovered and were expected to buy for April or second quarter at the minimum asking price of $2 have decided to buy prompt lots from time to time and have supplied their immediate requirements at about $1.95, expecting to do still lower within a fortnight. The coke trade is hearing rumors of furnaces likely to blow out and thus release coke, while there are no reports of any likely to blow in.

CHEMICALS

NEW YORK—April 8

The general markets remain quiet and buying seems to be on a moderate scale only.

Arsenic—The market is quiet and unchanged. The price seems fixed at $3 per 100 lb. Sales have been a little more active.

Copper Sulphate—Business is rather more active, but prices are unchanged. The quotations are $4.80 per 100 lb. for carload lots and $5.05 per 100 lb. for smaller parcels.

Nitrate of Soda—Business is reported good both here and abroad, and demand seems to be improving. Quotations are unchanged so far, the current price being 2.25c. per lb. for spot and May; 2.22½c. for June and later deliveries.

Exports and Imports of Chemicals and raw materials in the United States for the month of January:

	Imports		Exports	
Chemicals:	1913	1914	1913	1914
Arsenic, lb.	754,093	532,343	.....	.....
Copper sulphate, lb.	.....	.....	1,192,850	757,682
Bleach, lb.	6,426,217	5,365,604	.....	.....
Potash salts, lb.	3,642,374	3,595,832	51,241	188,686
Soda salts, lb.	1,520,451	1,394,641	40,298	45,112
Acetate of lime, lb.	.....	.....	5,546,525	6,251,429
Sulphur, tons	1,898	1,686	6,656	2,761
Ores, etc.:				
Pyrites, tons	98,207	86,458	.....	.....
Chrome ore, tons	5,000	10,320	.....	.....
Magnesite, tons	18,174	17,230	339	342
Fertilizers:				
Kainit, tons	72,003	68,509	.....	.....
Mercury salts, tons	23,613	25,694	.....	.....
Other potash salts, tons	25,824	36,322	483	497
Nitrate of soda, tons	37,119	32,609	357	120
Sulphate of ammonia, tons	8,493	10,487	.....	.....
Phosphates, tons	.....	.....	69,693	94,327

Exports include reëxports of imported material of all kinds. Some phosphate is imported, but is not given separately in the returns.

PETROLEUM

Oil production in California in February is reported at 7,855,708 bbl.; deliveries, 7,367,064 bbl. Stocks on Feb. 28 were 49,797,204 bbl. There were 36 new producing wells completed during the month, and 244 wells were under the drill at the close.

The monthly statement of the "Oil City Derrick" shows new wells completed in March as follows: Pennsylvania grades, 425; Lima, Indiana, 144; Kentucky, 13; Illinois, 136; Kansas-Oklahoma, 1180; Texas-Louisiana, 228. A grand total of 2136 wells was completed with an initial production of 131,603 bbl. There were 382 dry holes and 118 gas wells. At the close of March, the new work consisted of 779 rigs and 2330 drilling wells, a total of 3109, a net gain of 117 over the February report.

COPPER SMELTER'S REPORTS

This table is compiled from reports received from the respective companies except in the few cases noted (by asterisk) as estimated, together with the reports of the U. S. Dept of Commerce as to imported material, and in the main represents the crude copper content of blister copper, in pounds. In those cases where the copper contents of ore and matte are reported, the copper yield then is reckoned at 97%. In computing the total American supply duplications are excluded.

	November	December	January	February	March
Alaska shipments	3,391,300	3,104,155	2,701,258	1,803,579	.....
Anaconda	25,250,000	25,100,000	24,400,000	21,300,000	.....
Arizona, Ltd.	2,800,000	2,920,000	3,474,000	3,062,000	.....
Copper Queen	7,115,991	9,033,459	8,796,358	6,987,366	7,637,042
Calumet & Ariz.	4,600,000	5,230,000	5,975,000	5,596,850	.....
Chino	4,270,821	4,390,018	6,488,220	5,642,426	.....
Detroit	1,922,352	2,021,034	1,590,681	1,814,214	1,973,725
East Butte	1,002,190	1,324,560	1,256,000	1,193,960	.....
Giroux	250,000	197,649	148,411	90,017	.....
Mason Valley	1,174,000	1,372 000	944,000	.....	.....
Mammoth	1,700,000	1,400,000	1,625,000	1,400,000	1,800,000
Nevada Con.	5,443,647	5,343,862	5,791,122	4,588,243	.....
Ohio	772,120	722,940	700,728	582,000	.....
Old Dominion	2,450,000	2,613,039	2,797,000	3,066,000	.....
Ray	4,753,964	5,075,202	5,705,000	5,432,000	.....
Shannon	1,110,000	1,078,000	937,432	903,761	1,082,000
South Utah	225,072	242,362	275,569	333,874	.....
Tennessee	1,666,753	1,700,000	1,474,890	1,232,812	.....
United Verde*	3,000,000	3,000,000	3,000,000	2,700,000	.....
Utah Copper Co.	10,787,426	10,306,646	10,329,564	.....	.....
Lake Superior*	6,600,000	5,600,000	7,400,000	8,500,000	.....
Non-rep. mines*	6,000,000	6,250,000	6,200,000	5,600,000	.....
Total prod.	96,285,636	98,024,926	102,100,233	.....	.....
Imp., bars, etc.	21,796,866	23,578,938	24,504,249	.....	.....
Total blister	118,082,502	121,603,864	126,604,482	.....	.....
Imp. ore & matte	8,080,186	12,205,187	10,893,969	.....	.....
Total Amer.	127,062,688	133,809,053	137,498,451	.....	.....
Miami†	3,230,000	3,210,000	3,258,950	3,316,482	3,361,100
Shattuck-Arizona	995,429	1,050,781	1,276,636	1,134,480	.....
Brit. Col. Cos.:					
British Col. Cop.	655,637	795,004	607,930	.....	.....
Granby	1,944,145	1,605,382	1,793,840	1,661,212	.....
Mexican Cos.:					
Boleo†	2,315,040	2,315,040	2,369,920	1,984,080	.....
Cananea	3,800,000	3,646,000	3,460,000	2,688,000	.....
Moctezuma	3,517,800	3,139,613	3,024,556	2,642,543	2,882,884
Other Foreign:					
Braden, Chile	1,592,000	2,122,000	2,430,000	2,362,000	.....
Cape Cop., S. Af.	649,600	683,200	519,680	459,200	.....
Kyshtim, Russia.	1,624,000	1,742,720	1,559,040	1,534,500	.....
Spassky, Russia.	904,960	900,480	902,720	902,720	.....
Exports from					
Chile	7,616,000	10,640,000	5,488.000	6,720,000	.....
Australia	11,200,000	6,720,000	·,712,000	7,952,000	.....
Arrivals-Europe‡	9,107,840	13,787,200	8,599,360	18,354,560	.....

† Boleo copper does not come to American refiners. Miami copper goes to Cananea for treatment, and reappears in imports of blister.
‡ Does not include the arrivals from the United States, Australia or Chile.

STATISTICS OF COPPER

	United States			Visible Stocks.		
Month	U.S.Refin'y Production	Deliveries, Domestic	Deliveries, for Export	United States	Europe	Total
Year, 1912	1,581,920,287	819,665,948	746,396,452	.....	.....	.....
IV, '13.	135,353,402	78,158,837	85,894,727	104,269,270	87,180,800	191,450,070
V.	141,319,416	81,108,321	68,285,978	75,549,108	85,948,800	161,497,908
VI.	121,860,853	68,362,571	68,067,901	67,474,225	77,235,200	144,709,425
VII.	138,074,602	58,904,192	78,480,071	52,814,606	77,904,000	124,808,606
VIII.	131,632,362	73,649,801	73,263,469	53,594,945	66,420,480	120,015,385
IX.	131,401,229	66,836,897	73,085,275	38,314,037	63,716,800	102,030,837
X.	139,070,481	68,173,720	68,123,473	29,793,094	53,625,600	83,418,692
XI	134,087,708	48,656,858	70,067,803	32,566,382	48,787,200	81,353,582
XII.	138,990,421	21,938,570	73,542,413	47,929,429	46,592,000	94,521,429
Yr., '13	1,622,450,829	767,261,760	869,062,784	.....	.....	.....
I, 1914.	131,770,274	47,956,955	87,955,501	91,438,867	53,916,800	145,355,667
II.	122,561,007	47,586,657	83,899,183	87,296,685	50,108,800	137,405,485
III.	145,651,982	69,852,349	89,562,166	78,371,852	47,376,000	125,747,852
IV.	.....	.....	.....	64,609,319	46,435,200	111,044,519

Note—Visible supplies in Europe do not include copper afloat.

Assessments

Company	Delinq.	Sale	Amt.
American Copper, Utah	Mar. 9	Apr. 15	$0.001
Aurora-Sampson, Ida. post'd		Apr. 10	0.002
Blue Bell, Ida	Feb. 9	Apr. 15	0.003
Caledonia, Nev	Apr. 7	Apr. 29	0.10
C. & R., Ida., post'd		Apr. 24	0.005
Consolidated Virginia, Nev	Apr. 10	May 1	0.10
Demijohn	Apr. 1	Apr. 20	0.0025
Eagles Nest, Nev	Mar. 20	Apr. 23	0.005
Emerald Tintic, Utah	Apr. 15	May 9	0.0033
Giant, Ida	Mar. 13	Apr. 17	0.001
Great Western, Nev	Apr. 6	Apr. 28	0.01
Idaho-Montana Ida., post'd		Apr. 18	0.001
Liberty, Utah	Mar. 28	Apr. 16	0.01
Mass Cons., Mich	Apr. 7		1.00
Mono, Utah	Apr. 1	Apr. 18	0.0025
Nevada Silver Reed, Utah	Apr. 6	Apr. 27	0.001
New York, Nev	Apr. 6	Apr. 27	0.05
Ophir, Nev	Apr. 7	Apr. 29	0.10
Samson, Ida	Mar. 28	Apr. 28	0.002
Savage, Nev	Apr. 16	May 7	0.10
Southern Swansea, Utah	Apr. 18	May 6	0.0003
Tintic-Central, Utah	Apr. 11	Apr. 29	0.005
Tintic-Delmar, Nev	Mar. 30	Apr. 18	0.002
Tonopah-Gypsy Queen, Nev	Mar. 25	Apr. 29	0.01
Tonopah-Panama Pacific, Nev.	Mar. 15	Apr. 16	0.0025
Utah-Arizona, Utah	Apr. 4	Apr. 22	0.0025
Verda, Utah	Apr. 15	May 5	0.001
Victoria, Mich	Apr. 15	May 24	1.00
Western Union, Utah	Mar. 31	Apr. 20	0.0025
Wisconsin, Utah	Apr. 3	May 5	0.003

Monthly Average Prices of Metals

SILVER

Month	New York			London		
	1912	1913	1914	1912	1913	1914
January	56.260	62.938	57.572	25.887	28.983	26.553
February	59.043	61.642	57.506	27.190	28.357	26.573
March	58.375	57.870	58.067	26.875	26.669	26.788
April	59.207	59.490	.....	28.284	27.416	.....
May	60.880	60.361	.....	28.038	27.825	.....
June	61.290	58.990	.....	28.215	27.199	.....
July	60.654	58.721	.....	27.919	27.074	.....
August	61.606	59.293	.....	28.375	27.335	.....
September	63.078	60.640	.....	29.088	27.986	.....
October	63 471	60.793	.....	29.299	28.083	.....
November	62.792	58.995	.....	29.012	27.263	.....
December	63.365	57.760	.....	29.320	26.720	.....
Year	60.835	59.791	.....	28.042	27.576	.....

New York quotations, cents per ounce troy, fine silver; London, pence per ounce, sterling silver, 0.925 fine.

COPPER

Month	New York				London Standard	
	Electrolytic		Lake			
	1913	1914	1913	1914	1913	1914
January	16.488	14.223	16.767	14.772	71.741	64.304
February	14.971	14.491	15.253	14.946	65.519	65.259
March	14.713	14.131	14.930	14.625	65.329	64.276
April	15.291	.....	15.565	.....	68.111	.....
May	15.436	.....	15.738	.....	68.807	.....
June	14.672	.....	14.871	.....	67.140	.....
July	14.190	.....	14.563	.....	64.166	.....
August	15.400	.....	15.904	.....	69.200	.....
September	16.328	.....	16.799	.....	73.125	.....
October	16.337	.....	16.913	.....	73.383	.....
November	15.182	.....	16.022	.....	68.275	.....
December	14.224	.....	14.904	.....	65.223	.....
Year	15.269	.....	15.686	.....	68.335	.....

New York, cents per pound. London, pounds sterling per long ton of standard copper.

TIN

Month	New York		London	
	1913	1914	1913	1913
January	50.298	37.779	238.273	171.905
February	48.766	39.830	220.140	181.556
March	46.832	38.038	213.615	173.619
April	49.115	.....	224.159	.....
May	49.038	.....	224.143	.....
June	44.820	.....	207.208	.....
July	40.260	.....	183.511	.....
August	41.582	.....	188.731	.....
September	42.410	.....	193.074	.....
October	40.462	.....	184.837	.....
November	39.810	.....	180.869	.....
December	37.635	.....	171.786	.....
Av. year	44.252	.....	206.279	.....

New York in cents per pound; London in pound sterling per long ton.

LEAD

Month	New York		St. Louis		London	
	1913	1914	1913	1914	1913	1914
Jauuary	4.321	4.111	4.171	4.011	17.114	19.665
February	4.325	4.048	4.175	3.937	16.550	19.606
March	4.327	3.970	4.177	3.850	15.977	19.651
April	4.381	.....	4.242	.....	17.597	.....
May	4.342	.....	4.226	.....	18.923	.....
June	4.325	.....	4.190	.....	20.226	.....
July	4.353	.....	4.223	.....	20.038	.....
August	4.624	.....	4.550	.....	20.406	.....
September	4.698	.....	4.579	.....	20.648	.....
October	4.402	.....	4.253	.....	20.302	.....
November	4.293	.....	4.146	.....	19.334	.....
December	4.047	.....	3.929	.....	17.798	.....
Year	4.370	.....	4.238	.....	18.743	.....

New York and St. Louis cents per pound. London, pounds sterling per long ton.

SPELTER

Month	New York		St. Louis		London	
	1913	1914	1913	1914	1913	1914
January	6.931	5.262	6.854	5.112	26.114	21.583
February	6.239	5.377	6.089	5.227	25.338	21.413
March	6.078	5.250	5.926	5.100	24.605	21.460
April	5.641	.....	5.491	.....	25.313	.....
May	5.406	.....	5.256	.....	24.583	.....
June	5.124	.....	4.974	.....	22.143	.....
July	5.278	.....	5.128	.....	20.592	.....
August	5.658	.....	5.508	.....	20.706	.....
Septemher	5.694	.....	5.444	.....	21.148	.....
October	5.340	.....	5.188	.....	20.614	.....
November	5.229	.....	5.083	.....	20.581	.....
December	5.156	.....	5.004	.....	21.214	.....
Year	5.648	.....	5.504	.....	22.746	.....

New York and St. Louis, cents per pound. London, pounds sterling per long ton.

PIG IRON IN PITTSBURGH

Month	Bessemer		Basic		No. 2 Foundry	
	1913	1914	1913	1914	1913	1914
January	$18.15	$14.94	$17.35	$13.23	$18.59	$13.90
February	18.15	15.06	17.22	14.12	18.13	14.09
March	18.15	15 07	16.96	13.94	17.53	14 18
April	17.90	.....	16.71	.....	16.40	.....
May	17.68	.....	15.80	.....	15.40	.....
June	17.14	.....	15.40	.....	15.10	.....
July	16.31	.....	15.13	.....	14.74	.....
August	16.63	.....	15.00	.....	14.88	.....
September	16.65	.....	15.04	.....	14.93	.....
October	16.60	.....	14.61	.....	14.80	.....
November	16.03	.....	13.91	.....	14.40	.....
December	15.71	.....	13.71	.....	14.28	.....
Year	$17.09	.....	$15.57	.....	$15.77	.....

STOCK QUOTATIONS

COLO. SPRINGS Apr. 7

Name of Comp.	Bid.
Acacia	.02⅛
Cripple Cr'k Con	.007
C. K. & N	.08
Doctor Jack Pot	.05¼
Elkton Con	.45⅛
El Paso	2.00
Findlay	.02
Gold Dollar	.04
Gold Sovereign	.02½
Golden Cycle	‡1.50
Isabella	.11⅛
Jack Pot	.05¼
Jennie Sample	.04
Jerry Johnson	.03½
Lexington	.003
Old Gold	.01
Mary McKinney	.55½
Pharmacist	.01
Portland	1.10
Vindicator	.95

SALT LAKE Apr. 7

Name of Comp.	Bid.
Beck Tunnel	.04
Black Jack	.06
Cedar Talisman	.01
Colorado Mining	.10
Crown Point	.02⅜
Daly-Judge	5.15
Gold Chain	.13
Grand Central	‡.55
Iron Blossom	1.27½
Little Bell	.15
Lower Mammoth	.02
Mason Valley	1.00
May Day	.06
Nevada Hills	.30
Prince Con	.22
Silver King Coal'n	3.05
Silver King Cons	1.95
Sioux Con	.02½
Uncle Sam	.03
Yankee	‡.04

TORONTO Apr. 7

Name of Comp.	Bid.	Name of Comp.	Bid.
Bailey	.03½	Foley O'Brien	.25
Coniagas	8.00	Hollinger	16.15
Peterson Lake	.40½	Imperial	.01½
Right of Way	.04⅜	Jupiter	.12½
T. & Hudson Bay	73.50	Pearl Lake	.07½
Timiskaming	.15	Porcu. Gold	.11
Wettlaufer-Lor	.06	Preston E. D	.02⅜
Big Dome	9.50	Rea	.20
Crown Chartered	.00½	Swastika	.03
Dome Exten	.10	West Dome	.10

SAN FRANCISCO Apr. 7

Name of Comp.	Bid.	Name of Comp.	Bid.
Comstock Stocks		Misc. Nev. & Cal.	
Alta	.02	Belmont	7.75
Belcher	.32	Jim Butler	.95
Best & Belcher	.05	MacNamara	.08
Caledonia	.52	Midway	.33
Challenge Con	.05	Mont.-Tonopah	.91
Chollar	.01	North Star	.33
Confidence	.30	West End Con	.79
Con. Virginia	.20	Atlanta	.33
Crown Point	‡.45	Booth	.05
Gould & Curry	.02	C.O.D. Con	.07
Hale & Norcross	.03	Comb. Frac	.08
Mexican	1.10	Jumbo Extension	.30
Occidental	.70	Pitts.-Silver Peak	.35
Ophir	.42	Round Mountain	.28
Overman	.15	Sandstorm Kendall	.10½
Potosi	.01	Silver Pick	.07
Savage	.02	Argonaut	2.50
Sierra Nevada	.17	Bunker Hill	‡1.90
Union Con	.10	Central Eureka	.62
Yellow Jacket	.30	So. Eureka	1.50

N. Y. EXCH. Apr. 7

Name of Comp.	Clg.
Amalgamated	77⅛
Am.Sm.&Ref.,com	69½
Am. Sm. & Ref., pf.	102⅛
Am. Sm. Sec., pf. B	84⅛
Anaconda	35⅛
Batopilas Min	⅛
Bethlehem Steel, pf.	84
Chino	42⅛
Colo. Fuel & Iron	32
Federal M. & S., pf.	35
Great Nor., ore., ctf	34⅛
Guggen. Exp	.56
Homestake	119½
Inspiration Con	18⅛
Miami Copper	23⅛
Nat'l Lead, com	46⅛
National Lead, pf	107
Nev. Consol	15⅛
Phelps Dodge	183
Pittsburg Coal, pf.	92
Quicksilver, pf	2
Ray Con	22⅛
Republic I&S, com	24
Republic I&S, pf	87
SlossSheffi'd, com	30
Sloss Sheffield, pf	89
Tennessee Copper	35
Utah Copper	57⅛
U. S. Steel, con	63⅛
U. S. Steel, pf	110⅛

N. Y. CURB Apr. 7

Name of Comp.	Clg.
Ariz. Belmont	‡.03½
Barnes King	‡1⅛
Beaver Con	.31
Big Four	.09
Boston Montana	8⅛
Braden Copper	8⅛
B. C. Copper	1⅛
Buffalo Mines	1⅛
Can. Cop. Corpn	2⅛
Can. G. & S	.08
Caribou	.70
Con. Ariz. Sm	⅛
Coppermines Cons	2⅛
Davis-Daly	⅛
Diam'field-Daisy	.05½
Ely Con	.04⅛
Florence	.63
Gold Hill Con	.75
Goldfield Con	1 7/16
Greene Cananea	37
Greenwater	.06½
Internat. S. & R	‡106
Kerr Lake	4⅛
La Rose	1⅛
McKinley-Dar-Sa	.80
Mines of Am	‡2⅛
New Utah Bingham	.68
Nipissing Mines	6⅛
Ohio Copper	⅜
Oro	.14
Puebla S. & R	2⅛
South Utah M&S	‡.25
Stand'd Oil of N.J.	412
Stand'd Silver Lead	1 11/16
Stewart	1 5/16
Tonopah	61
Tonopah Ex	2 1/16
Tonopah Merger	.61
Tri-Bullion	‡⅛
Tularosa	‡1/16
Yukon Gold	3

LONDON Mar. 27

Name of Comp.	Clg.
Camp Bird	£0 12s 3d
El Oro	0 13 9
Esperanza	0 17 6
Mexico Mines	5 2 6
Oroville	0 12 6
Santa Gert'dis	0 16 9
Stratton's	0 0 6
Tomboy	1 3 9

BOSTON EXCH Apr. 7

Name of Comp.	Clg.
Adventure	1⅛
Ahmeek	285
Alaska Gold M	24⅛
Algomah	1⅛
Allouez	41⅛
Am. Zinc	16⅛
Ariz. Com., ctfs	4⅛
Bonanza	.51
Butte & Balak	2⅛
Calumet & Ariz	68⅛
Calumet & Hecla	416
Centennial	16⅛
Cliff	1
Copper Range	37⅛
Daly West	2⅛
East Butte	11
Franklin	6⅛
Granby	88⅛
Hancock	18
Hedley Gold	30
Helvetia	.42
Indiana	4
Island Cr'k, com	47⅛
Island Cr'k, pfd	86
Isle Royale	19⅛
Keweenaw	3 1/16
Lake	7⅛
La Salle	4⅛
Mass	4
Michigan	.75
Mohawk	43⅛
New Arcadian	4⅛
New Idria Quick	3⅛
North Butte	27⅛
North Lake	1⅛
Ojibway	1⅛
Old Dominion	50⅛
Osceola	78⅛
Quincy	61
Shannon	5⅛
Shattuck-Ariz	26
Superior	30
Superior & Bost	2
Tamarack	36
Trinity	3⅛
Tuolumne	.60
U. S. Smelting	38⅛
U. S. Smelt'g, pf	47⅛
Utah Apex	1⅛
Utah Con	10⅛
Victoria	1
Winona	3⅛
Wolverine	45
Wyandot	.60

BOSTON CURB Apr. 7

Name of Comp.	Bid.
Bingham Mines	.05
Boston & Corbin	.30
Boston Ely	.38
Butte & Lon'n Dev.	.50
Cactus	.01
Calaveras	1⅛
Chief Cons	.93
Corbin	‡.80
Cortez	.25
Crown Reserve	1⅛
Eagle & Blue Bell	1 1/16
First Nat. Cop	2 1/16
Houghton Copper	3
Majestic	.22
Mexican Metals	.17
Moneta Porc	‡.02
Nevada-Douglas	.86
New Baltic	1 1/16
Oneco	1⅛
Raven Copper	.16
Rhode Island Coal	‡.01
Smokey Dev	‡.25
So. Lake	4
S. W. Miami	1⅛
Tonopah Victor	.30
Trethewey	.23
United Verde Ext	.85

‡Last Quotation.